Technical Report CHL-99-1
January 1999

US Army Corps of Engineers
Waterways Experiment Station

Coastal Inlets Research Program

Ponce de Leon Inlet, Florida, Site Investigation

Report 1
Selected Portions of Long-Term Measurements, 1995-1997

by David B. King, Jr., Jane M. Smith, Adele Militello, Donald K. Stauble, Terry N. Waller

WES

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Prepared for Headquarters, U.S. Army Corps of Engineers

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Report 1 of a series
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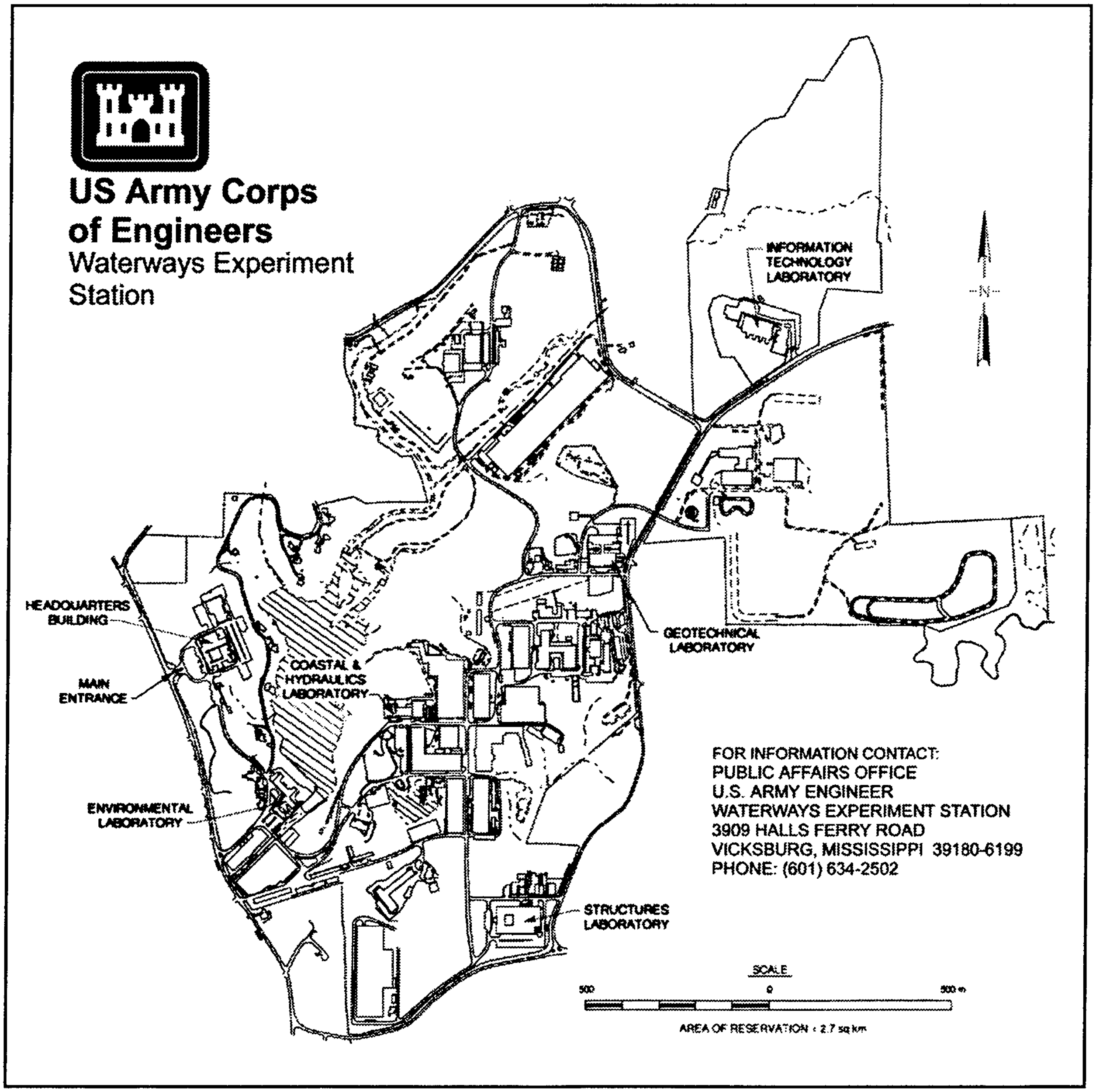
Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Under CIRP Inlet Field Investigations WU 32931



Waterways Experiment Station Cataloging-in-Publication Data

Ponce de Leon Inlet, Florida, site investigation. Report 1, Selected portions of long-term measurements, 1995-1997 / by David B. King ... [et al.] ; prepared for U.S. Army Corps of Engineers.
147 p. : ill. ; 28 cm. — (Technical report ; CHL-99-1 rept. 1)
Includes bibliographic references.
Report 1 of a series.
1. Ocean waves — Measurement. 2. Wind waves — Measurement. 3. Inlets — Florida. 4. Ponce de Leon Inlet (Fla.) I. King, David B. (David Byron) II. United States. Army. Corps of Engineers. III. U.S. Army Engineer Waterways Experiment Station. IV. Coastal and Hydraulics Laboratory (U.S. Army Engineer Waterways Experiment Station) V. Coastal Inlets Research Program (U.S.) VI. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; CHL-99-1 rept.1
TA7 W34 no.CHL-99-1 rept.1

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Preface

The study described herein was conducted by the U.S. Army Engineer Waterways Experiment Station (WES), Coastal and Hydraulics Laboratory (CHL). The work was performed under Work Unit 32931 "Inlet Field Investigations" (IFI) in the Coastal Inlets Research Program (CIRP). Additional funding for field work was supplied by the U.S. Army Engineer District, Jacksonville (SAJ).

During the design, site selection, and deployment phase of the project, Mr. Gary L. Howell of the Coastal Sediments and Engineering Division (CS&ED), CHL, was the CIRP Principal Investigator (PI) of the IFI Work Unit. Mr. W. Jeff Lillycrop of the Coastal Evaluation and Design Branch (CE&DB), CHL, was the Technical Area Leader responsible for the work unit. Following a reorganization of CIRP in 1997, Mr. Thad C. Pratt of the Hydraulic Analysis Group (HAG), CHL, became the PI of the IFI Work Unit, and Dr. Nicholas C. Kraus (CS&ED), CHL, the Technical Coordinator. The CIRP Program Manager during the study was Mr. E. Clark McNair, Jr. Technical Monitors of CIRP at Headquarters, U.S. Army Corps of Engineers, were Mr. John P. Bianco, Mr. Charles B. Chesnutt, and Mr. Barry W. Holliday.

Several WES personnel made substantial contributions to the data collection effort. Planning for the data collection and deployment was managed by Mr. Paul Puckette, formerly of the Prototype Measurement and Analysis Branch (PMAB), CHL. The field data collection computers were programmed by Mr. Troy Nelson, formerly of PMAB. Construction and deployment of the field instrumentation were supervised by Mr. William E. Grogg, formerly of PMAB. Field deployment team members included Mr. Ralph E. Ankeny, Mr. Larry G. Caviness, and Charles J. Mayers, all of PMAB. Mr. Lillycrop and the Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS) team performed the bathymetric surveys. Mr. Michael W. Leffler of the WES Field Research Facility (FRF) coordinated the beach profile surveys. Dr. Donald K. Stauble (CE&DB) coordinated the collection of sediment samples. Mr. Kent K. Hathaway (FRF) coordinated the collection of video imagery. Time series data collection, analysis, and quality control were coordinated by Mr. William D. Corson, along with Ms. Rhonda Lofton and Mr. James P. McKinney, all of PMAB.

Several persons outside WES also participated. Mr. Thomas Martin (SAJ) was the project liaison with the Jacksonville District. Mr. Daniel O'Brien of the Ponce de Leon Port Authority provided local coordination and assistance obtaining permission for occupying the gauge sites. The U.S. Coast Guard station at New Smyrna provided

valuable support as well as the site for the data collection trailer. Mr. Larry Devers of the Inlets Condominium coordinated the use of the building for the video cameras. Mr. Henry Pate of the Battelle Institute paint test facility provided the meteorological data. Aerial photography and image rectification were provided by Spacecoast Micro Map Corporation and Aerial Cartographics of America, Inc. Evans-Hamilton, Inc. provided both installation support and on-site maintenance for the duration of data collection. Dr. Gary Zarillo of the Florida Institute of Technology, working under contract through Evans Hamilton, Inc., collected extensive additional data during the August-October 1997 short-term experiment.

Dr. David B. King, Jr. (PMAB), along with Dr. Jane M. Smith of the Coastal Processes Branch (CPB), CHL, Ms. Adele Militello of the Coastal Hydrodynamics Branch (CHB), CHL, and Dr. Stauble wrote the body of the report. Mr. Terry N. Waller, along with Mr. Pratt, Ms. Clara J. Coleman, and Mr. Tim L. Fagerburg, all of HAG, wrote Appendix A. Ms. J. Holley Messing (CPB) coordinated report preparation.

Supervision of various aspects of the data collection and report preparation was performed by the following division and branch personnel: Mr. Thomas W. Richardson, Chief, CS&ED; Mr. William A. Birkemeier, Chief, FRF; Mr. Bruce A. Ebersole, Chief, CPB; Ms. Joan Pope, Chief, CE&DB; Mr. William L. Preslan, Chief, PMAB; Mr. C. E. Chatham, Jr., Chief, Navigation and Harbors Division; Dr. Martin C. Miller, Chief, CHB; Mr. William H. McAnally, Jr., Chief, Estuaries and Hydroscience Division; and Mr. Fagerburg, Chief, HAG.

The Director and Assistant Director of CHL were Dr. James R. Houston and Mr. Charles C. Calhoun, Jr., respectively. At the time of this report publication, WES Commander was COL Robin R. Cababa, EN, and the WES Director was Dr. Robert W. Whalin.

1 Introduction

Ponce de Leon Inlet Field Study

The Coastal Inlets Research Program (CIRP) was initiated in 1993 by the U.S. Army Engineer Waterways Experiment Station (WES) of the U.S. Army Corps of Engineers (USACE) as the first comprehensive program to study inlet behavior since the General Investigation of Tidal Inlets Program of the 1970's. The Inlet Field Investigations work unit within CIRP was tasked with choosing an initial inlet for field study. Careful planning was required to balance limited resources with investigator needs. Both technical and operational characteristics of candidate inlets from around the country were evaluated. Criteria for selection included such factors as the availability of historical data sets, engineering problems at the inlet, and suitability of the inlet for field measurements and for physical model studies. At the time of the selection process, a physical model study of Ponce de Leon Inlet was underway at WES (Harkins, Puckette, and Dorrell 1997). As a result of the lengthy selection process, Ponce de Leon Inlet was recommended and approved as the initial CIRP field study site.

The long-term comprehensive monitoring program at Ponce de Leon Inlet began in September 1995, and ran through October 1997. The data collection consisted of multiple gauge sites to collect data on wave height, wave period, wave direction, water level, current velocity, and wind velocity. Additional data were provided through bathymetry surveys, the collection of sediment samples, and inlet monitoring with video imagery and aerial photography.

Location

Ponce de Leon Inlet is located along the east coast of Florida at Latitude 29°05'N, Longitude 80°55'W. The inlet is in Volusia County approximately 20 km south of Daytona Beach, 75 km northeast of Orlando, and 80 km north-northwest of Cape Canaveral. The inlet connects the Atlantic Ocean with the Halifax and Indian Rivers, both of which join the Intracoastal Waterway. Ponce de Leon Inlet is the only inlet to drain the Halifax River Lagoon to the north and is the principal inlet for the Indian River to the south. Rockhouse Creek is a short channel to the dredged Intracoastal Waterway bypass to the west. The location of the inlet and a site map are shown in Figures 1 and 2, respectively.

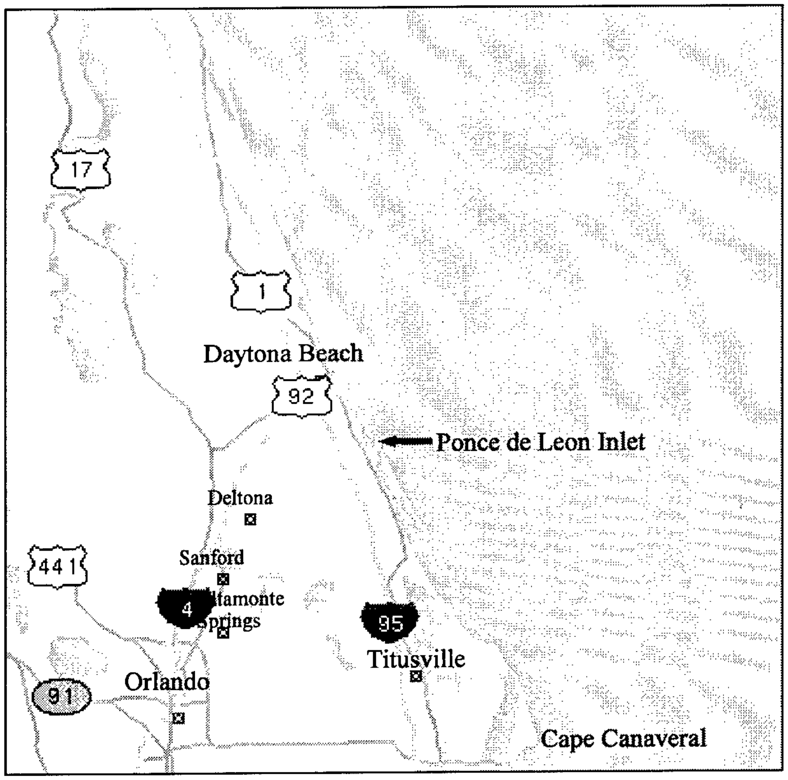

Figure 1. Study location (1 cm equals approximately 17 km)

Figure 2. Site map (1 cm equals approximately 500 m)

Inlet History

Ponce de Leon Inlet has existed as a natural inlet in its approximate present location since at least the time of the Spanish explorer Ponce de Leon when he noted the inlet in his log in 1513 (Jones and Mehta 1978). The first major bathymetric survey was done in May 1925 by the Coast and Geodetic Survey. In 1932/33, the Intracoastal Waterway was rerouted to the west of the inlet by dredging a bypass channel, due to problems navigating through the dynamic flood shoal. The inlet became non-navigable and was dredged and surveyed in August 1943 and again in October 1944 by the U.S. Army Engineer District, Jacksonville (SAJ), for the war effort. Prior to jetty construction in 1968, the inlet was recognized as difficult and dangerous to navigate with controlling depths over the ebb shoal of typically 1.2 to 1.8 m.

Funding for a weir jetty system at Ponce de Leon Inlet was authorized under the River and Harbor Act adopted 27 October 1965. The weir system was designed so that sand moving down from the north would pass through the weir section of the north jetty and deposit in the adjacent impoundment basin. This basin was to be periodically dredged and the sand placed south of the inlet. Construction occurred from 1967 to 1972. Following construction, the project did not perform as anticipated. As early as August 1972 riprap was placed beside sections of the north jetty to provide scour protection. Because the weir section was not functioning as planned, it was partially closed in 1979 and fully closed in 1984. The inlet continues to experience shoaling, scour, and navigation problems today.

There have been several previous field studies of Ponce de Leon Inlet. A partial list of published reports includes: U.S. Army Engineer District, Jacksonville (1963, 1967, 1983), Purpura et al. (1974), Purpura (1977), Hemsley and Briggs (1988), Taylor (1989), Taylor et al. (1990), Taylor, Yanez, and Hull (1992), and Waller et al. (1997) (which is included in this report as Appendix A).

Data Collection Time Periods

Three time periods within the 2-year deployment (September 1995 to October 1997) were selected for detailed analyses. These time periods were selected based on data requirements for numerical model development and validation. The parameters for selecting the time periods included: time periods when most or all the in situ gauges were functioning, storm conditions, near-continuous spring-neap tidal cycles, and data coincident with short-term data collection in the fall of 1997.

20 February - 20 March 1996

This period was selected because it included a major storm during 8-14 March. The storm's peak on 11 March produced wave heights over 5 m, a storm surge of 0.5 m, and a wind speed of 17 m/sec. During this time period all the wave and water level gauges were working, except for one wave gauge on the ebb shoal that failed during the peak of the storm. The current meters were not operational. The main interest in this time period was in modeling the shoaling, refraction, and breaking of the storm waves.

Data from this period were used to test two Coastal and Hydraulics Laboratory numerical models at WES; ADCIRC and STWAVE. The ADCIRC (Advanced Circulation) model is a two- or three-dimensional (2- or 3-D) coastal circulation model, and the STWAVE (Steady-state Spectral Wave) model is a spectral wave model with wave-current interaction. These applications are discussed in Smith, Militello, and Smith (1998).

1 July - 31 August 1996

This period was selected to include two full spring-neap tidal cycles with all wave, water level, and current gauges operating. The period provided additional data for numerical model validation. During the 2-month period, a storm on 11 July had wave heights over 2.5 m, and three other events (on 17 July, 21 August, and 31 August) had wave heights exceeding 1 m. Winds exceeded 16 m/sec during the 17 July and 21 August events. The winds during these 2 months show a typical land and sea breeze pattern.

1 August - 31 October 1997

This period was selected to coincide with short-term measurements made at Ponce de Leon Inlet. The short-term measurements included current and bathymetry surveys over the ebb shoal, inlet throat, and in bay channels during neap tide (25-29 August) and spring tide (15-19 September) conditions. The short-term measurements also included a 72-day deployment (21 August - 31 October 1997) of six additional wave and current gauges located in the inlet throat and in the bay to supplement the long-term wave, water level, and current measurements. Unfortunately, many of the long-term gauges were inoperable. During this time period there were three large wave events: 1.5-m waves on 27 August, 2.3-m waves on 5 September, and waves exceeding 1 m during 8-18 October.

Scope of Report

The purpose of this report is to document the available data, document the data collection and processing procedures, and present examples of the long-term field data collected at Ponce de Leon Inlet. These data are currently being applied in CIRP analyses and modeling studies, and it is anticipated that they will continue to be used extensively in the future. Potential users include not only researchers in the CIRP and at WES, but also SAJ, the State of Florida, and others in industry and academia.

Chapter 2 of this report discusses the types of data collected, the instruments used, and the processing procedures. Chapter 3 discusses examples of the data. Appendix A is a report on current measurements made at the inlet in August and September 1997. Appendix B presents selected aerial photos.

2 Instrumentation and Procedures

The long-term comprehensive monitoring program consisted of multiple gauge sites to collect data on wave height, wave period, wave direction, water level, current velocity, and wind velocity. Additional data were provided through bathymetry surveys, sediment sample collection, and inlet monitoring with video imagery and aerial photography.

Instrument Locations

Figure 3 shows the locations of data collection gauges at Ponce de Leon Inlet. Wave gauges were at Sites A, B, and C; and current meters were at Sites B and C. Site A was north of the inlet in about 15 m of water in a region where the bathymetric contours are relatively straight and parallel to shore. This site was intended to measure the incident wave conditions. Site B was centered on the seaward face of the ebb shoal in about 7 m of water. Site C was in the outer inlet throat at about the 5-m depth. A stilling well water level gauge was at the Coast Guard Station at Site D. Pressure type water level gauges were at Sites E, F, and G. The wave gauges at Sites A, B, and C were also used to obtain water levels. Wind speed and direction, air temperature, relative humidity, and barometric pressure were measured at the meteorological station operated by the Battelle Institute at Site H. The data acquisition electronics were housed in a trailer located at Site J, which also had a barometer. The coordinates of these locations are given in Table 1.

Data Collection System

Data from the wave, water level, and current gauges were collected continuously (in real-time mode) and transmitted to WES in Vicksburg, MS, via the Internet for daily processing. Data from the ebb shoal and inlet throat pods, Sites B and C, were cabled directly to the data collection trailer (Site J). The north pod (Site A) was cabled to shore at the Battelle site (Site H). These data were sent to the data trailer via telephone line. The data from the pressure tide gauges at Sites E, F, and G were also transmitted to the data trailer via telephone line. Data from the tide gauge at the Coast Guard station (Site D) were radioed to the data trailer. The Ethernet network in the data trailer was connected to the Internet via a leased line to SAJ. The meteorological data from the Battelle site were separately transmitted to WES via telephone line.

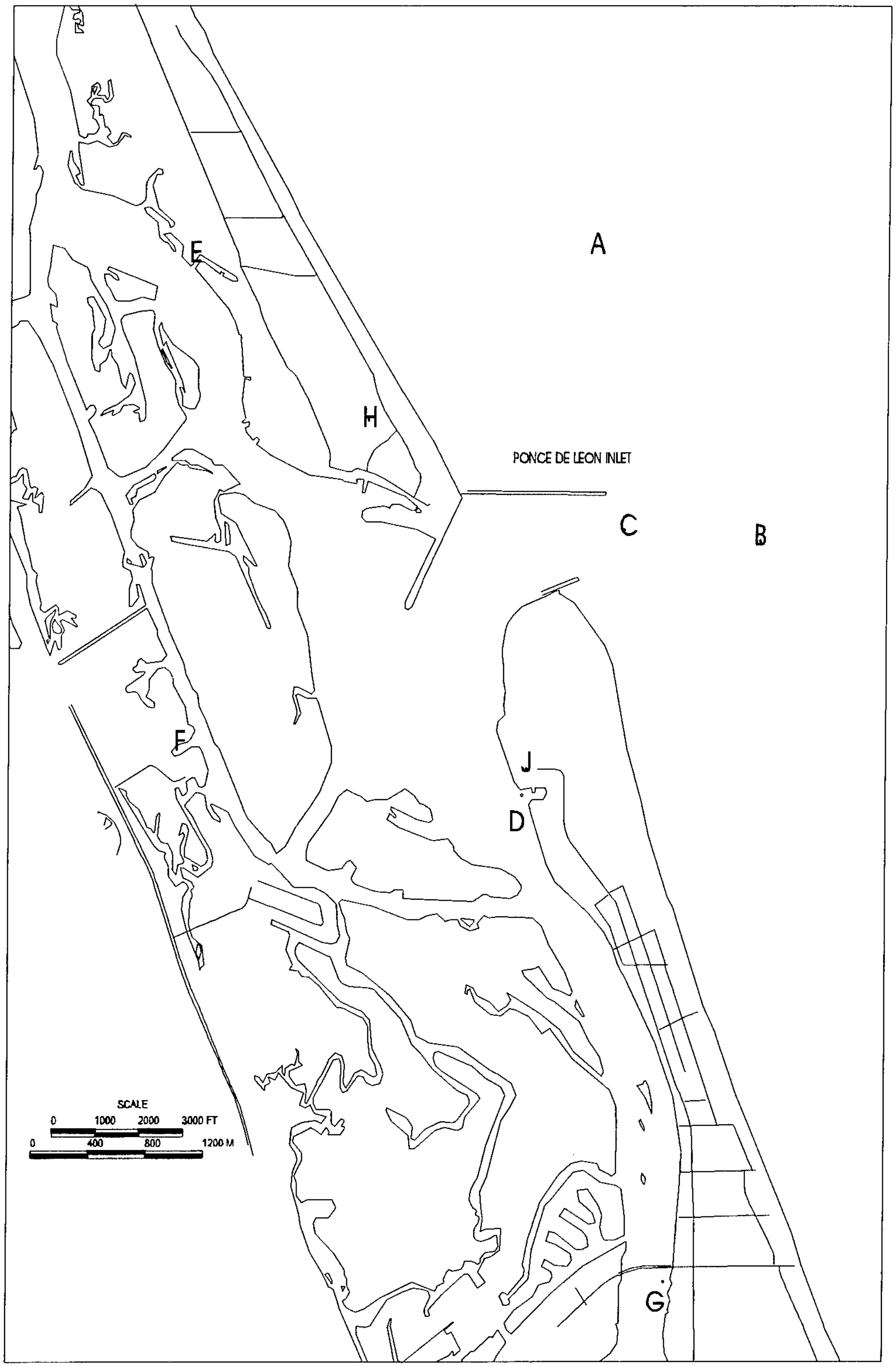

Figure 3. Location of instruments

Table 1 Gauge Locations				
Site	Name	Latitude	Longitude	Gauges
A	Offshore	29° 05.462 'N	80 ° 54.620' W	DWG1INT1
B	Ebb Shoal	29° 04.565' N	80 ° 53.902' W	DWG1EBB1
				ADCPEBB1
C	Inlet Throat	29° 04.605' N	80 ° 54.489' W	DWG1OTH1
				ADCPOTH1
D	Coast Guard	29° 03.776' N	80 ° 54.909' W	VITLBAY3
E	River North	29° 05.453' N	80 ° 56.332' W	SPRSBAY1
F	River West	29° 03.944' N	80 ° 56.322' W	SPRSBAY2
G	River South	29° 02.266' N	80 ° 54.299' W	SPRSBAY3
H	Battelle	29° 04.933' N	80 ° 55.581' W	Meteorology
J	Data Trailer	29° 03.868' N	80 ° 54.902' W	Barometer

The data were received by a WES computer located in the Prototype Measurement and Analysis Branch (PMAB), Coastal and Hydraulics Laboratory (CHL), using a standard data acquisition, analysis, and storage routine (McKinney and Howell 1996). The entire system was designed to operate automatically and to provide high reliability. Extensive automated checks were incorporated to determine if the system was operating normally. If a problem was detected, automated E-mail warning messages were sent. Furthermore, the status of various systems in the on-site data collection trailer could be queried from WES. For a further description of this system, see Howell (1996).

Wave Measurements

Continuous, long-term wave measurements were made from 1995 to 1997 using three DWG1's, a gauge developed by PMAB. Each gauge consisted of three Paroscientific Digiquartz piezo-electric (Paros) pressure sensors mounted on a trawler-resistant seafloor pod in an equilateral triangle distribution. These gauges performed limited onboard data processing, then transmitted the information to shore through a cable, which also supplied power to the systems. The DWG1 is further described in Howell (1992). In all cases, pod orientation (necessary to determine wave direction) was determined by divers following deployment and checked during retrieval. Datasonic acoustic releasing transponders were used to assist in locating and recovering the equipment pods.

The output wave parameters were derived from a two-dimensional (2-D) power density spectrum of the sea surface using spectral analysis of the sensors' output and linear wave theory. The raw DWG1 wave data were collected at 5 Hz for 1 hr (17,000+ data points for each sensor). These were converted onboard to millimeters of seawater. After arrival at WES, the data were stored in a database.

A copy of the data was then automatically put through a routine analysis procedure. The data were first decimated to 1 Hz, then truncated to the first 2,048 decimated data points. An edit routine checked for spikes and flat spots. The data were then converted to pressure (newtons per square meter), detrended, and demeaned. An auto- and cross-correlation matrix was produced using a Welch method to produce 31 data segments (50 percent overlapping segments of 128 points each). Thus, the frequency resolution for this analysis was 1/128 sec or 0.00781 Hz. A 10-percent cosine taper (window) was applied to each segment. The resulting 2-D spectrum was then surface corrected on a frequency-band by frequency-band basis using linear wave theory. This spectrum was truncated when the surface correction factor exceeded 100. Because the three gauge sites were at different depths, each had a different minimum cut-off period; approximately 4.3 sec for the offshore gauge, 2.9 sec for the ebb shoal gauge, and 2.5 sec for the throat gauge.

The co-spectrum was then integrated to obtain the wave height. The frequency band of the co-spectrum with the maximum energy was used to designate the peak period. The quad-spectrum was used to determine the wave direction of the peak frequency. These wave parameters are defined as follows (see Earle, McGehee, and Tubman (1995) for additional information):

a. Zero Moment Wave Height (H_{m0}): Spectrally-derived wave height, in meters; equivalent to time-domain-derived significant wave height in deep water.

b. Peak Wave Period (T_p): Peak spectral period, in seconds; inverse of the frequency of the peak (highest energy) of the one-dimensional (1-D) power spectrum.

c. Peak Wave Direction (D_p): Peak spectral direction, in degrees clockwise from true north; mean direction from which energy is coming at the peak of the 1-D power spectrum.

The time stamp associated with these products refers to the time at the beginning of the 1-hr data record.

During very low-energy wave conditions, while H_{m0} can be calculated, the calculation of other wave parameters is difficult, subject to greater relative error, and may be misleading. Therefore, wave period and direction calculations were omitted from the data set whenever the wave height dropped below a threshold of 0.2 m.

Application of these wave parameters to engineering solutions requires judgement and understanding of their limitations. Critical decisions should take all available information, such as the directional spectra of the original measured time series, into account. However, heuristic rules of thumb have evolved among the wave measurement community that may be of assistance in utilizing these data. Reasonable assumptions for typical engineering applications with these data are that the uncertainty in significant wave height is on the order of 10 percent, and on the order of 10 deg for peak direction.

Uncertainty in peak period is affected more by resolution than measurement error. Peak period is the inverse of the center of the frequency band with the most total energy. This band, whose width is set by the analysis procedure, effectively averages energy from multiple discrete frequencies; and the true peak period could lie anywhere within that band. Conceivably, the spectrum could contain another discrete peak within another band that approaches, or even exceeds, the energy of any discrete frequency in the peak period band. Small variations in the values of these energies from hour to hour sometimes cause rapid changes in the reported peak period, particularly at low wave heights.

Examples of these wave data are given in Chapter 3. Table 2 shows the months for which the wave gauges were operational. Files containing these wave data are available on the World Wide Web at (http://sandbar.cerc.wes.army.mil/). Directional (2-D) wave spectral plots, which are not included in the examples shown in Chapter 3 or on the World Wide Web site, can also be obtained from the archived raw data.

Table 2
Wave Data Availability

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	DWG1INT1 Offshore										X	X	X
	DWG1EBB1 Ebb Shoal										X	X	X
	DWG1OTH1 Inlet Throat										X	X	X
1996	DWG1INT1 Offshore	X	X	X	X	X	X	X	X	X	X	X	X
	DWG1EBB1 Ebb Shoal	X	X	X		X	X	X	X	X	X	X	X
	DWG1OTH1 Inlet Throat	X	X	X	X	X	X	X	X	X	X	X	X
1997	DWG1INT1 Offshore	X	X	X	X								
	DWG1EBB1 Ebb Shoal	X	X	X	X		X	X	X	X	X		
	DWG1OTH1 Inlet Throat												

X indicates that a full or partial data set is available for that month.

Water Level Measurements

Water level was measured at four locations inside the inlet as shown in Figure 3. At three of these measurement stations (Sites E, F, and G), Paros pressure sensors were deployed; the same type of sensors as were used in the wave gauges. Each gauge was housed in a protective steel sleeve and attached to a piling. The fourth water level gauge was located at the Coast Guard Station just inside the inlet entrance (Site D). This gauge was a Vitel Model WLS2 stilling well tide gauge with an air acoustic sensor to measure the water surface elevation. These four gauges were surveyed in and their vertical datums referenced to National Geodetic Vertical Datum (NGVD) 1929 as described in John E. Chance & Associates (1996). The inlet throat and ocean wave gauges were also used as tide gauges. However, these were not surveyed in. Instead, long-term average values were used as reference mean water levels as described in Howell (1996).

The bay pressure gauges were sampled at a 1-Hz rate. Water levels were reported as 6-min averages of these samples (360 data points). Measurements made between 1:00 and 1:06 were reported as the 1:06 average. Water levels obtained from the six pressure gauges needed to be corrected for changes in atmospheric pressure. This adjustment was made by using another Paros pressure gauge housed in the data trailer as a barometer and subtracting out the air pressure. Table 3 shows the availability of the water level data. For the fully analyzed data, the elevations are available in meters relative to NGVD 1929 (approximately mean sea level).

The Paros gauges were calibrated before deployment. Their resolution is approximately ±2 mm, and their precision is on the order of ±1 cm. Examples of the water level data from the three time periods of interest are given in Chapter 3.

Current Measurements

The current meters were RD Instruments broad band 1,200-kHz Acoustic Doppler Current Profilers (ADCPs). These instruments were mounted horizontally on the same pods as the DWG1s and were oriented upward-looking through the use of a right angle head. Each shared a data and power cable with the wave sensors. For further information on this instrument, see the RD Instruments World Wide Web site (http://www.adcp.com/).

The ADCPs divided the water column into a maximum of 13 vertical bins, each 0.5 m long, and computed velocities in each bin. As is typical with ADCPs, data collected at the top and bottom bins were not usable. The ADCPs sampled at 1 Hz. The samples were first decimated to 0.1 Hz, then averaged in 6-min intervals, then bins 3 through 5 were averaged together (creating a 6-min average of the velocity between 1.0 and 2.5 m above the bed). The east/west and north/south components of these 6-min averages were reported in meters per second (north and east directions are positive). The time stamp associated with each average refers to the time at the beginning of the average.

Table 4 shows the availability of the current data. However, these data have recently been found to have a problem with the time code. This problem is under review, and thus, these data are not generally available for public release.

Chapter 3 gives examples of these data. In addition, Appendix A contains a report of the ADCP current measurements made during the short-term experiment (August and September 1997). A neap tide current survey was conducted on 25-29 August, and a spring tide current survey was conducted 2 weeks later on 15-19 September 1997.

Table 3
Water Level Data Availability

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	DWG1INT1 Offshore										X	X	A
	DWG1EBB1 Ebb Shoal										X	X	A
	DWG1OTH1 Inlet Throat										X	X	A
	VITLBAY3 Coast Guard												A
	SPRSBAY1 River North												A
	SPRSBAY2 River West												A
	SPRSBAY3 River South												A
1996	DWG1INT1 Offshore	A	A	A	X	X	X	A	A	X	X	X	X
	DWG1EBB1 Ebb Shoal	A	A	A		X	X	A	A	X	X	X	X
	DWG1OTH1 Inlet Throat	A	A	A	X	X	X	A	A	X	X	X	X
	VITLBAY3 Coast Guard	A	A	A	X	X	X	A	A	X	X	X	X
	SPRSBAY1 River North	A	A	A	X	X	X	A	A	X	X	X	X
	SPRSBAY2 River West	A	A	A	X	X	X	A	A	X	X	X	X
	SPRSBAY3 River South	A	A	A	X	X	X	A	A	X	X	X	X
1997	DWG1INT1 Offshore	X	X	X	X								
	DWG1EBB1 Ebb Shoal	X	X	X	X		X	A	A	A	X		
	DWG1OTH1 Inlet Throat												
	VITLBAY3 Coast Guard	X	X	X	X		X	A	A	A	X		
	SPRSBAY1 River North	X	X	X	X		X	A	A	A	X		
	SPRSBAY2 River West	X											
	SPRSBAY3 River South	X	X	X	X		X	A	A	A	X		

A indicates that a full or partial data set is available for that month.
X indicates that a full or partial data set is available for that month, however, the data have not been elevation corrected to NGVD and have not had a final quality control check.

Table 4
Current Data Availability

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	DWG1EBB1 Ebb Shoal												X
	DWG1OTH1 Inlet Throat												
1996	DWG1EBB1 Ebb Shoal	X	X	X	X	X	X	X	X	X	X	X	X
	DWG1OTH1 Inlet Throat						X	X	X	X	X	X	X
1997	DWG1EBB1 Ebb Shoal	X	X	X	X								
	DWG1OTH1 Inlet Throat												

X indicates that a full or partial data set is available for that month.

Meteorological Measurements

Wind speed and direction, air temperature, humidity, and barometric pressure were monitored at the Battelle site throughout the long-term data collection experiment. Barometric pressure was also measured at the data trailer.

The Battelle wind gauge was an R. M. Young Model 05103-U swivel propeller gauge mounted at an elevation of 10 m. The station is located approximately 200 m landward of the shoreline. The intervening terrain contains three rows of sand dunes which reach a maximum height of approximately 3 m. The Battelle meteorological station used a Vaisala Model CS105 gauge to measure barometric pressure and a Vaisala HMP 35 gauge to measure air temperature and relative humidity. The data trailer barometric pressure gauge was a Paros sensor of the same type used in the wave and water level gauges.

The Battelle gauges for the wind, barometric pressure, relative humidity, and air temperature were all sampled by the same method. One measurement for each parameter was obtained every 10 sec. These measurements were then averaged over an hour (with all data weighted equally), and this average hourly value was reported. Maximum wind gusts were also reported as the maximum 10-sec sample in the hour. The wind direction was a vector average of the direction the wind was coming from, measured clockwise from north. Measurements made between 1:00 and 2:00 were reported as the 1:00 average. If a data record had gaps, no average was reported for that hour. Gauges were calibrated yearly.

Chapter 3 gives examples of these meteorological data and their availability are shown in Table 5. In this table, "wind" refers to average speed and direction, and maximum gust speed and direction; "temperature" refers to temperature and relative humidity.

Table 5
Meteorological Data Availability

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	Wind												X
	Pressure												X
	Temperature												X
1996	Wind	X	X	X	X	X	X	X	X	X	X	X	X
	Pressure	X	X	X	X	X	X	X	X	X	X	X	X
	Temperature	X	X	X	X	X	X	X	X	X	X	X	X
1997	Wind	X	X	X	X				X	X	X		
	Pressure	X	X	X	X				X	X	X		
	Temperature	X	X	X	X				X	X	X		

X indicates that a full or partial data set is available for that month.

Bathymetry

Two rod and level beach profile surveys were conducted, one in September 1995, and the second in September 1996. During each survey, the same 33 profiles were measured north and south of the inlet. Profile lines were run from the State of Florida, Department of Environmental Quality, beach profile bench mark numbers R-121 to R-176, Volusia County. Profiles near the inlet (R-139 to R-148 and R-150 to R-160) were run at every bench mark. Further north (R-121 to R-136) and south (R-164 to R-176) of the inlet, every third bench mark was used. All profile lines ran north 60 deg east from the bench marks. Most profiles started at the bench mark and extended out to approximately 2 m depth.

Bathymetry throughout the inlet, back bays, beaches, and ocean was obtained during four SHOALS surveys, in July 1994, September 1995, September-October 1996, and December 1997. The SHOALS system consists of a helicopter-mounted laser that rapidly obtains above- and below-water vertical elevations using differential Global Positioning System (GPS) for horizontal control. The SHOALS Airborne Lidar Hydrographic Survey System is described in more detail in Irish, Lillycrop, and Parsons (1996) and Lillycrop, Parsons, and Irish (1996). See also the World Wide Web site (http://bigfoot.wes.army.mil/6022.html). The July 1994, Ponce de Leon SHOALS survey data are discussed in Irish, Parsons, and Lillycrop (1995) and Stauble (1998).

Sediment Collection

A set of 105 sediment samples was collected at Ponce de Leon Inlet from 18-22 September 1995. (A second set of 106 samples collected from 15-18 September 1997, at similar locations, has not been analyzed). Differential GPS was used to locate surface grab samples, which were collected by boat with a bucket dredge on the ebb and flood shoals and in the inlet throat. Surface grab samples were collected with a hand-held scoop on both the updrift and downdrift beaches and on some of the exposed flood deltas. These samples represent the present-day surface sediment distribution. Several patterns of sampling were applied, depending on the area of the inlet.

On the **ebb shoal** a radial pattern was sampled extending from the throat seaward over the back face, crest, and front face of the shoal on five radial lines for a total of 28 samples. Figure 70 and Table 7 (see Chapter 3, p. 58 "Sediment Results" Section) use the same notation presented in the following station descriptions. Line N (north transect) and Line NE (northeast transect) both had three samples. Line CL (the center line of the inlet channel) and Line SE (southeast transect) both had seven samples. Line S (south transect) had five samples. Three samples were also collected on a line parallel to the north jetty (NJ 1 to 3) to characterize the nearshore shelf sediment north of the jetty and ebb shoal. Three samples were taken on each of four transect lines across the **inlet throat** for a total of 12 samples. These channel samples were designated CH A1 through D3. Samples were collected in two environments at the flood shoal. Four samples were collected in each of three deeper **flood tidal channels**, which are for navigation into the Halifax River Lagoon to the north (NFC), Rockhouse Creek in the center (CFC), and in the Indian River North Lagoon, to the south (SFC). Five samples were collected on the two roughly triangular shaped **flood tidal shoals**, which were exposed at low tide and were designated as the north flood shoal (NFS) and south flood shoal (SFS). Twelve samples were collected in the flood channels and ten on the flood shoals. **Inlet-adjacent beaches** were also sampled along Florida Department of Environmental Protection profile lines, at the high-tide (HT), mid-tide (MT), low-tide (LT), and nearshore (OS) located approximately 61 to 76 m (200 to 250 ft) seaward of the mid-tide sample at time of low tide. Four profiles were located up to 1,829 m (6,000 ft) north of the inlet (R142 to R148) and six lines (R150 to R160) were located up to 3,048 m (10,000 ft) to the south.

Four additional beach samples were collected at the mid-tide location at sites south of the inlet: at R176 in New Smyrna Beach 6.9 km (11 miles) south of the inlet, at two sites at Bethune Beach 14.5 and 16.1 km (23.2 and 25.8 miles) south of the inlet, and at Canaveral National Seashore 30.6 km (49 miles) south of the inlet.

Visual Imaging

Six video cameras were set up on top of the Inlets Condominium just south of the inlet in positions that had clear views of the north and south coasts, the inlet, and the flood and ebb shoals. The cameras operated for most of the days between 28 February and 13 August 1996, when a presumed lighting strike destroyed some of the electrical components. During daylight hours the cameras were operated sequentially with each camera capturing one 6-min time-averaged video every hour. These images highlighted regions of significant wave breaking as bands of white. This imaging was of interest in determining regions of substantial wave energy dissipation to infer locations of substantial sediment transport. Control points in the video images along with camera locations have been surveyed in as discussed in Wood (1996a) and Wood (1996b). The video images have not yet been rectified or analyzed.

Five sets of aerial photographs were obtained during this study. All but the last were recorded as digital images. An index to these photo sets is given in Table 6. Examples of these images are shown in Appendix B. A source for a listing of older aerial photos of Ponce de Leon Inlet is included in Barwis (1975).

Table 6
Aerial Photography Sets

Date	Source	No. of Photos	Coverage
9/20/95	Spacecoast Micro Map Corp. P.O. Box 6484 Titusville FL 32782 407-383-0405	29	Inlet, north and south beach
3/21/96	Spacecoast Micro Map Corp.	22	North beach
8/24/96	Spacecoast Micro Map Corp.	5	North beach and flood shoal
9/24/96	Spacecoast Micro Map Corp.	14	Inlet, flood shoals, and south beach
9/10/97	Aerial Cartographics of America, Inc. 1722 W. Oak Ridge Road Orlando, FL 32809 407-851-7880	3	Inlet and shoals

3 Example Results and Discussion

This chapter provides example results and discussion of the wave, water level, current, and wind data collected in the three time periods (February-March 1996, July-August 1996, and August-October 1997). Plots of most of these data are shown. This chapter also includes a discussion of the sediment data collected in September 1995.

Wave Results

Wave height, period, and direction parameters are of interest for navigation safety and predicting sediment transport rates. Analyzed wave measurements are presented in plots of wave height, period, and direction at the offshore, ebb shoal, and inlet throat gauges (Sites A, B, and C, respectively, in Figure 3). Discussion of the measurements is arranged by wave parameter.

Wave height

Zero-moment wave heights for the offshore, ebb shoal, and inlet throat gauges for 20 February to 20 March 1996 are shown in Figures 4-6. The July 1996 data are shown in Figures 7-9; and the August 1996 data are shown in Figures 10-12. In the fall of 1997, only the ebb shoal wave gauge was operational. The ebb shoal wave heights for August, September, and October 1997 are given in Figures 13-15. The maximum wave height measured during the three time periods was 5.4 m at the offshore gauge on 11 March 1996 (Figure 4).

In general, the wave heights increase 20 to 30 percent between the offshore and ebb shoal gauges due to shoaling and refraction as the waves transform from a region of parallel contours and 15-m depth to the outer portion of the ebb shoal at a depth of 7 m. Between the ebb shoal gauge and inlet throat gauge at a depth of 5 m, the wave height generally decreases 10 to 20 percent due to wave focusing on the ebb shoal (south of the throat gauge). Wave height at the inlet throat gauge, and to a lesser degree at the ebb shoal gauge, increases at low tide due to greater wave shoaling. During high wave events, such as the peak of the March 1996 storm, this trend is reversed due to depth-limited wave breaking and the wave height is higher at high tide and lower at low tide (Figures 4-6). Wave height modulation of up to 1 m occurs at the inlet throat gauge, due to the tide.

During the peak of the 5.4-m wave event in March 1996, the waves were depth limited across the entire ebb shoal and near-inlet region. The height decreased 20 percent between the offshore and ebb shoal gauges and an additional 40 percent between the ebb shoal and inlet throat gauges at the peak of the event. This storm was numerically modeled for validation of wave and circulation models by Smith, Militello, and Smith (1998). In the 6 months of analysis, there are five events with wave heights exceeding 2 m. Some of these events are short in duration (e.g., the 5 September 1997 event, with a peak height of 2.3 m, exceeded 1 m in height for 3 days (Figure 14)). Others are much longer (e.g., the 11 October 1997 event, with a peak height of 2 m, exceeded 1 m in height for 11 days (Figure 15)). As expected, the large wave events are highly correlated to strong local winds.

Wave period

Peak wave periods from the three gauges for the three time periods are shown in Figures 16-27. The measured periods ranged from 3 to 21 sec. Generally, the peak periods are consistent from gauge to gauge for each time period and vary slowly with time. However, the difference in wave period between two gauges or between 2 hr at one gauge may vary by as much as 5 sec. These large variations typically occur at times when there are multiple frequency peaks in the spectra. This is evident in the frequency spectra for 28 August 1996 at 1800 Greenwich Mean Time (GMT), shown in Figure 28. The lower frequency peak (16-sec period) dominates at the offshore gauge, and the low-frequency peak becomes larger at the ebb shoal gauge due to shoaling and remains dominate. In the outer inlet throat, the higher frequency peak (9-sec period) dominates, due to refraction and possibly sheltering by the north jetty. Jumps in the peak period also occur at times with very low wave energy. Also, the high-frequency cutoff is different at each gauge because of the different water depths.

Wave direction

Peak wave directions from the three gauges for the three time periods are shown in Figures 29-40. The figures give the peak spectral direction from which the waves propagate, relative to true north. The wave direction normal to offshore depth contours at Ponce de Leon Inlet is about 60 deg. The average wave direction for the 6 months of data was approximately 70 deg. Most of the large wave events have north or northeast wave directions. At the offshore and ebb shoal gauges, the wave direction often varies by 5 to 10 deg from hour to hour. The variability at the inlet throat gauge is higher with hour-to-hour oscillations of 10 to 20 deg. Greater variability in wave direction (similar to the variability in wave period) is seen in some cases with multiple wave trains or cases with very low wave energy.

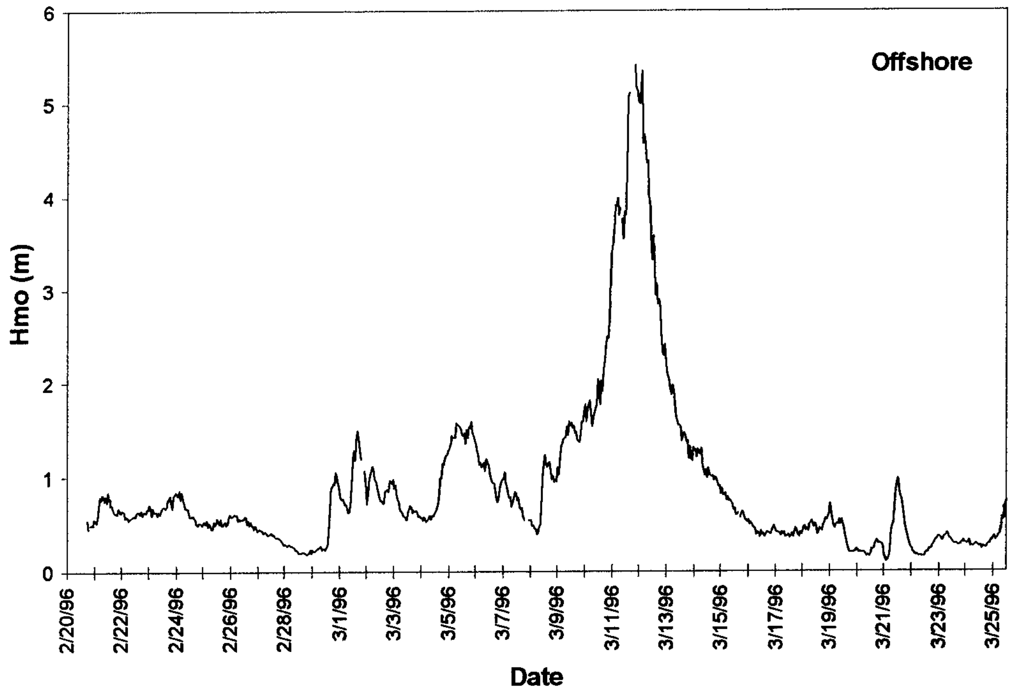

Figure 4. Zero-moment wave height at the offshore gauge for 20 February - 20 March 1996

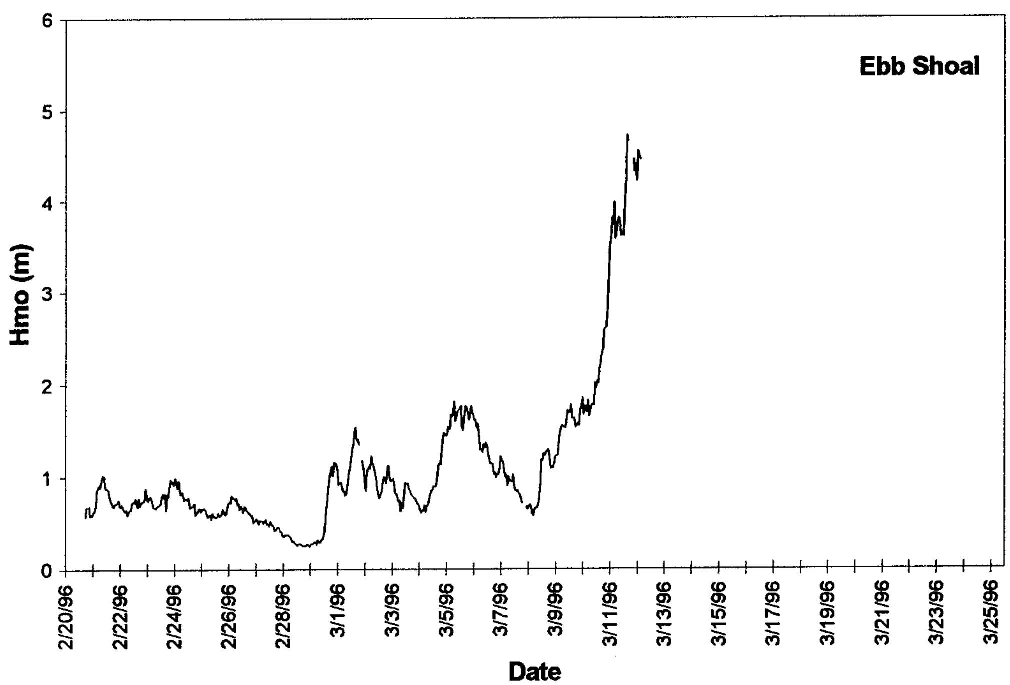

Figure 5. Zero-moment wave height at the ebb shoal gauge for 20 February - 20 March 1996

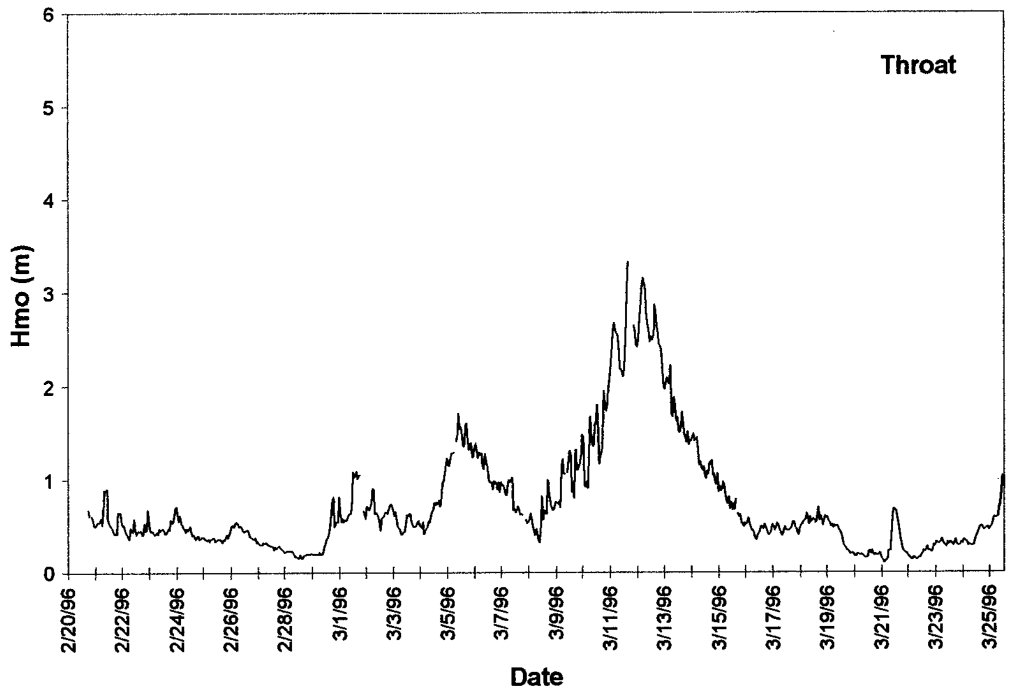

Figure 6. Zero-moment wave height at the inlet throat gauge for 20 February - 20 March 1996

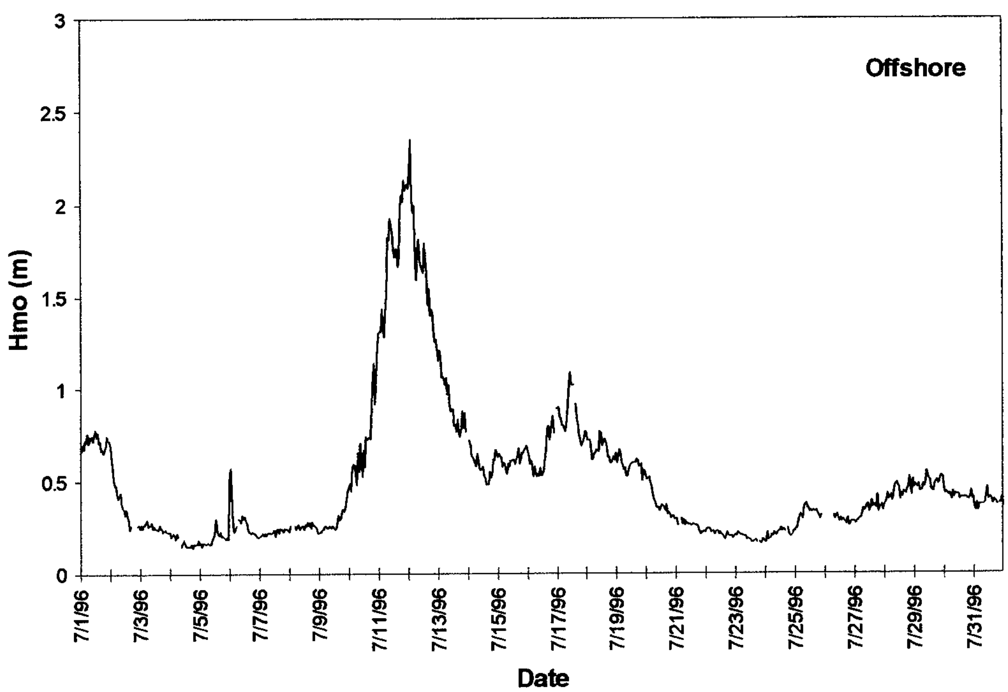

Figure 7. Zero-moment wave height at the offshore gauge for July 1996

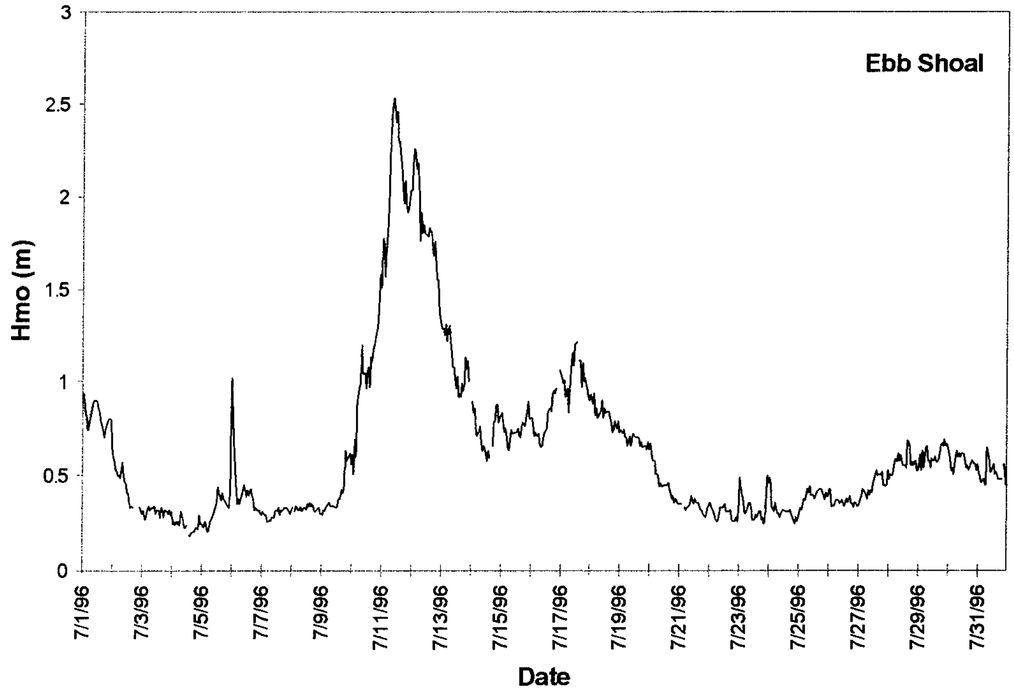

Figure 8. Zero-moment wave height at the ebb shoal gauge for July 1996

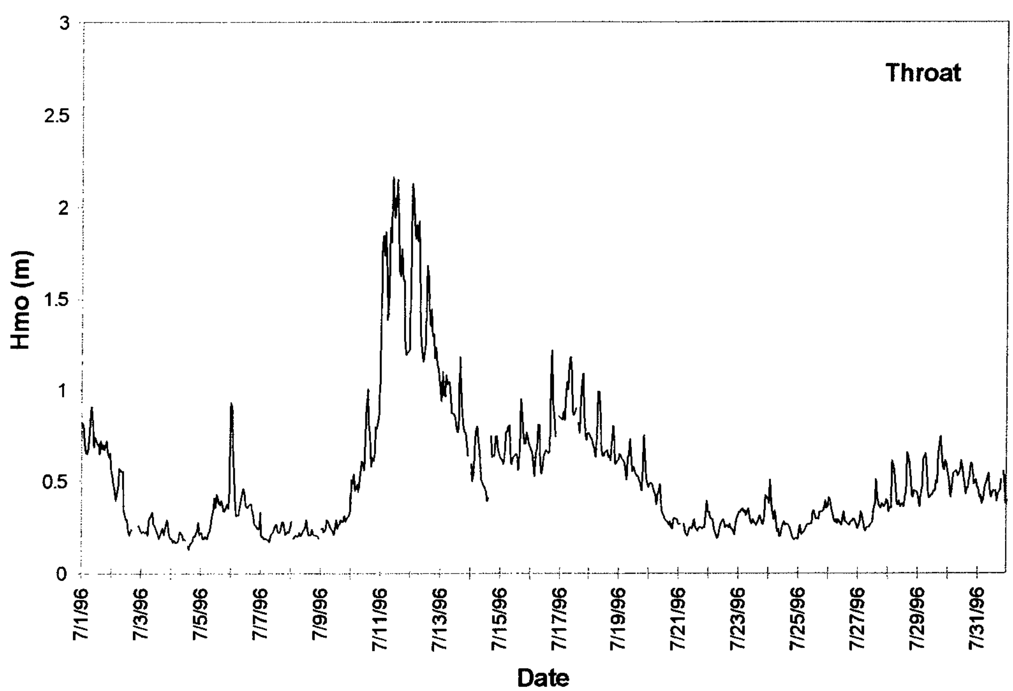

Figure 9. Zero-moment wave height at the inlet throat gauge for July 1996

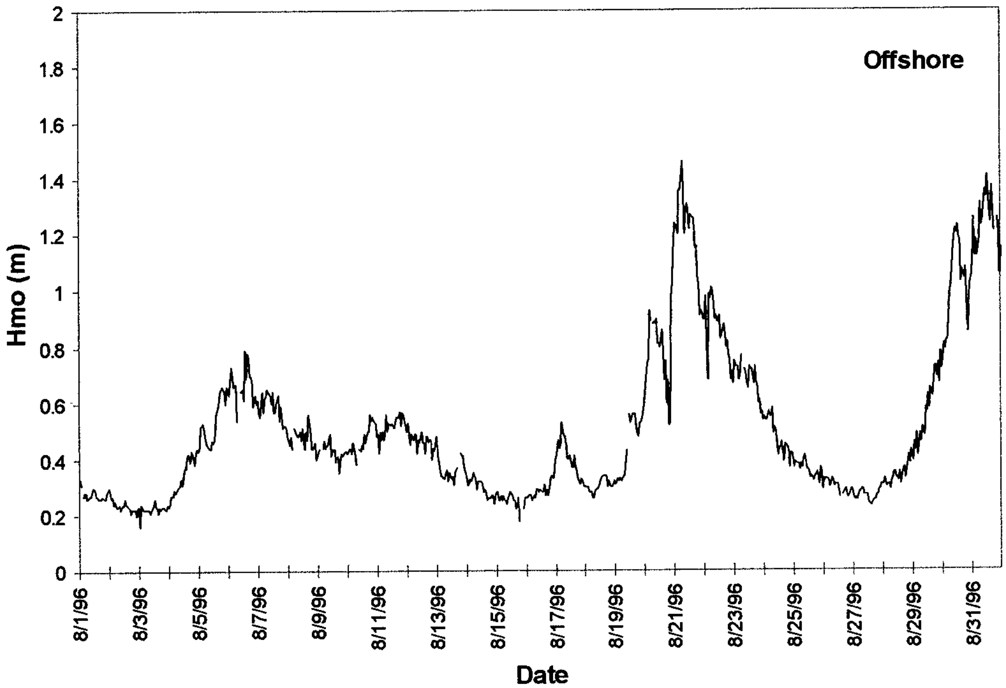

Figure 10. Zero-moment wave height at the offshore gauge for August 1996

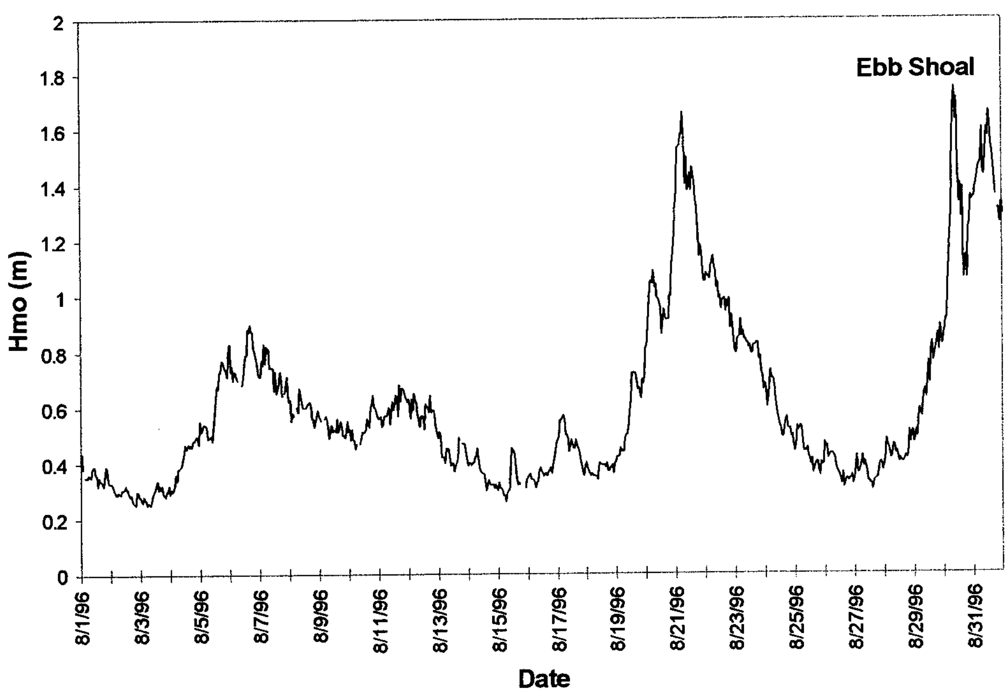

Figure 11. Zero-moment wave height at the ebb shoal gauge for August 1996

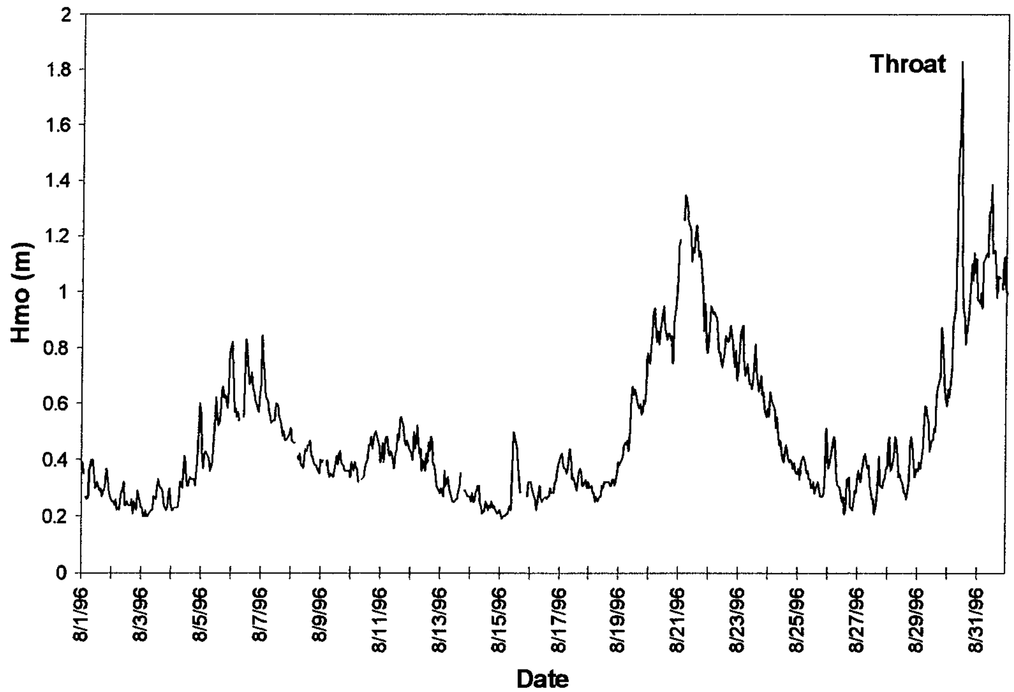

Figure 12. Zero-moment wave height at the inlet throat gauge for August 1996

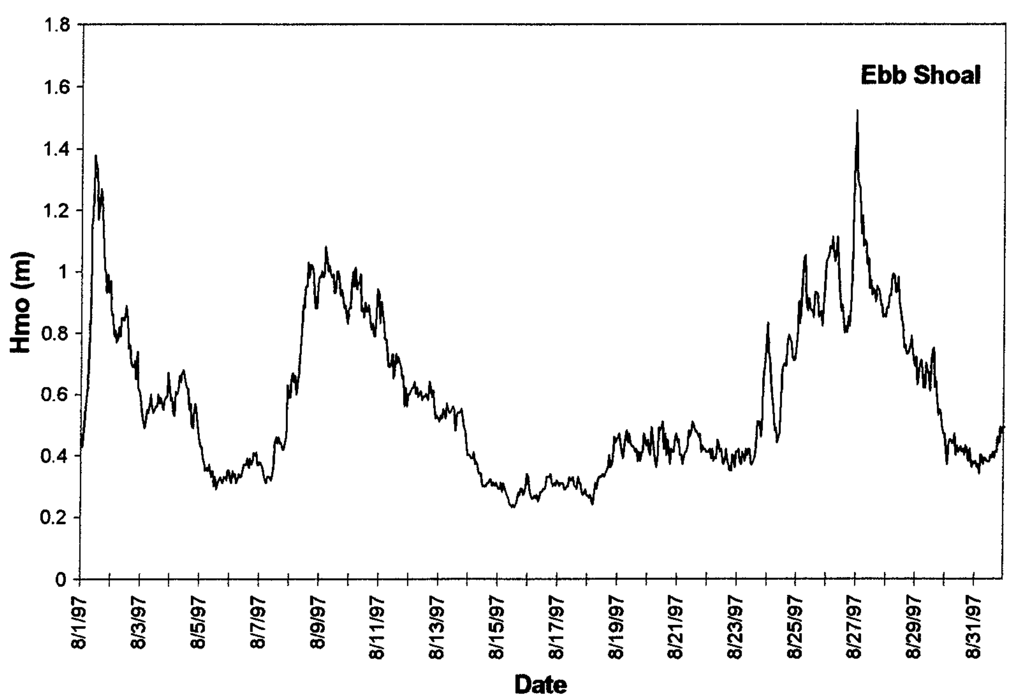

Figure 13. Zero-moment wave height at the ebb shoal gauge for August 1997

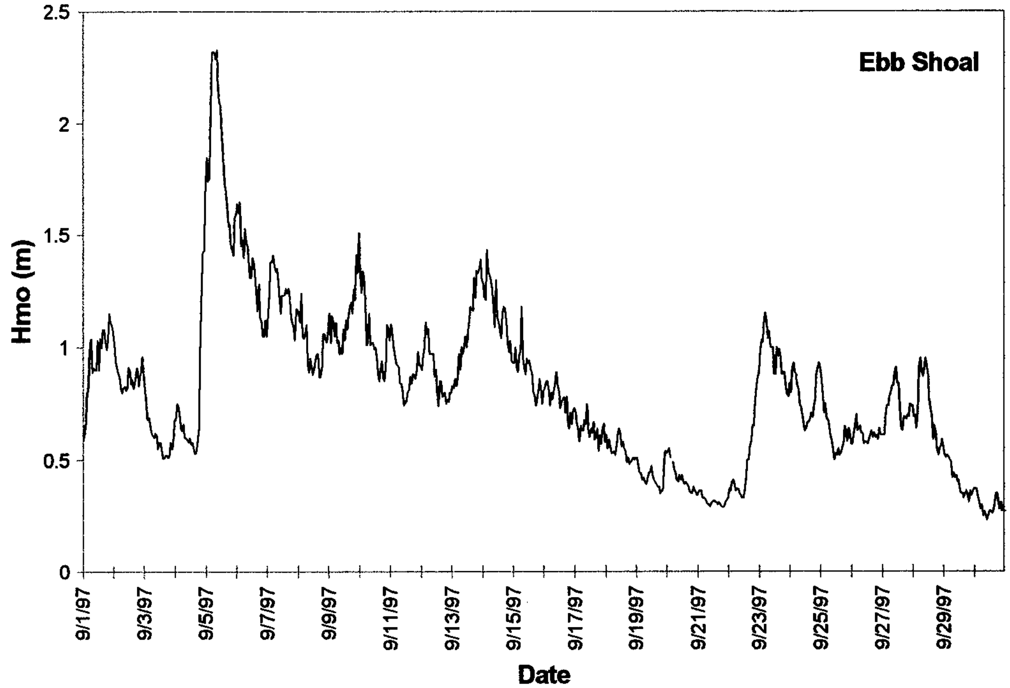

Figure 14. Zero-moment wave height at the ebb shoal gauge for September 1997

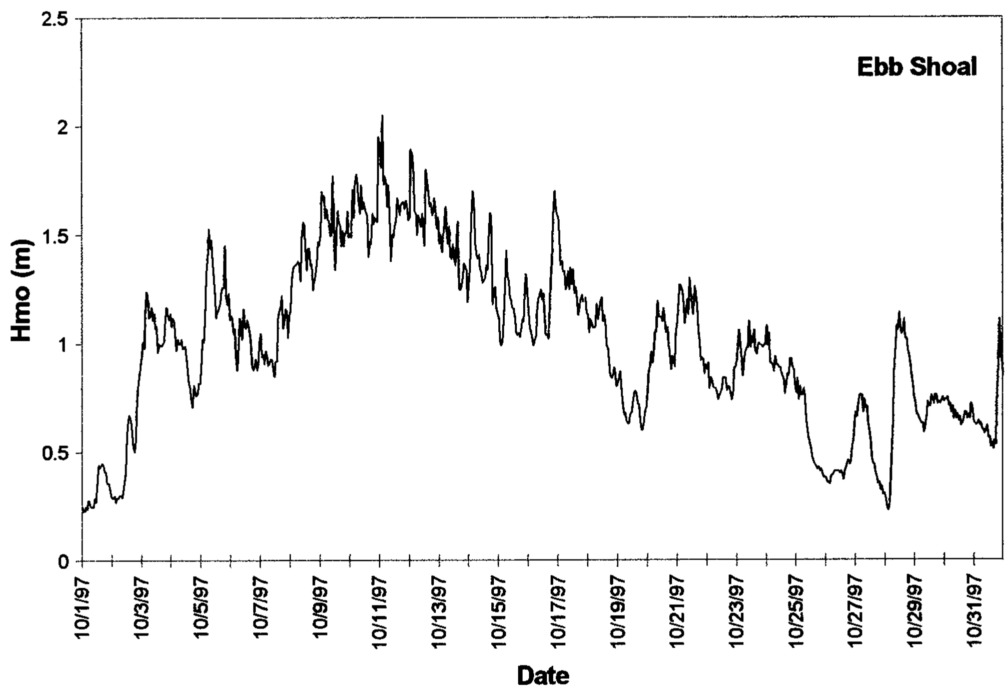

Figure 15. Zero-moment wave height at the ebb shoal gauge for October 1997

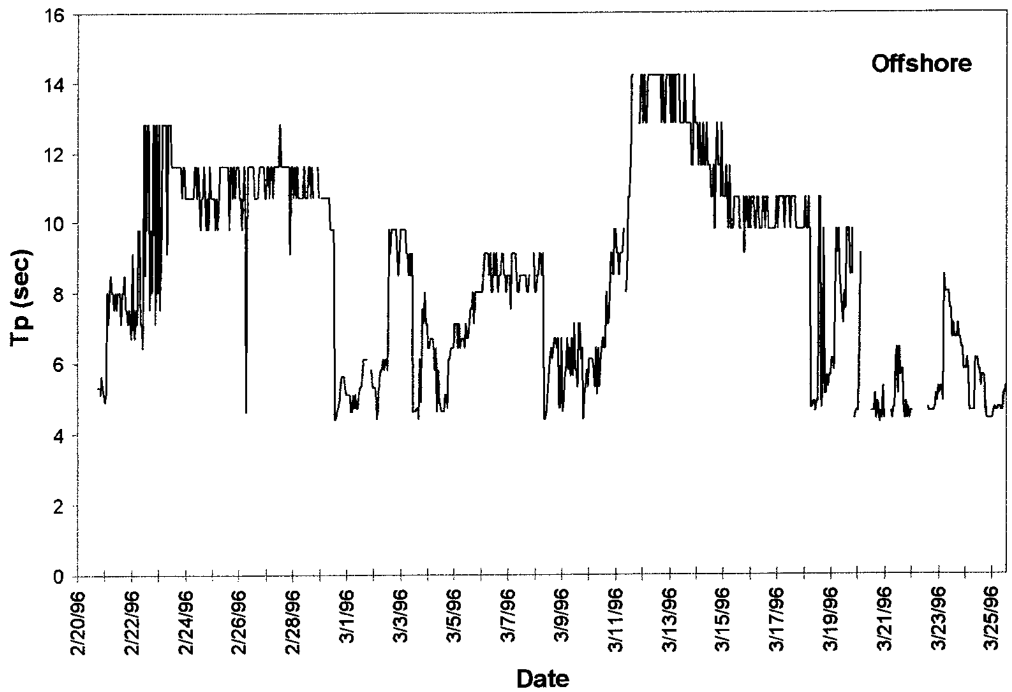

Figure 16. Peak wave period at the offshore gauge for 20 February - 20 March 1996

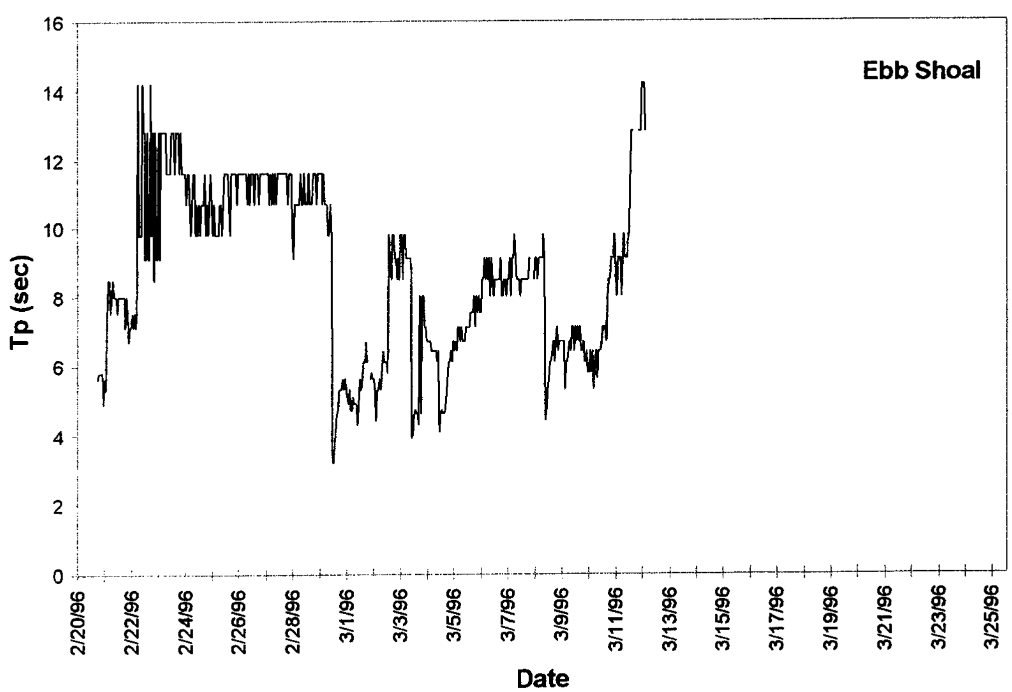

Figure 17. Peak wave period at the ebb shoal gauge for 20 February - 20 March 1996

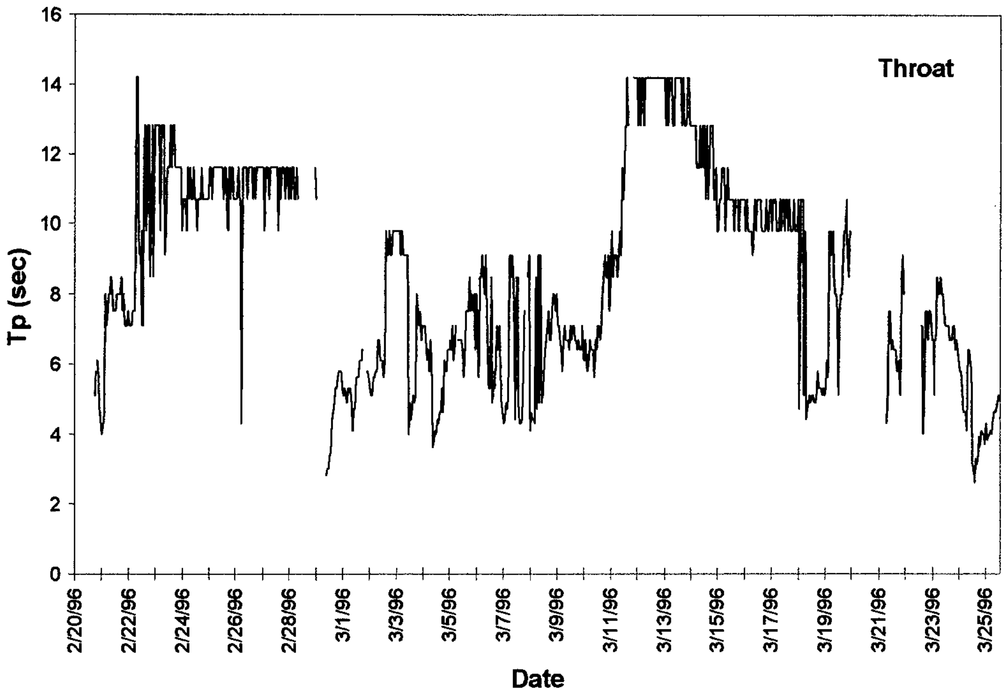

Figure 18. Peak wave period at the inlet throat gauge for 20 February - 20 March 1996

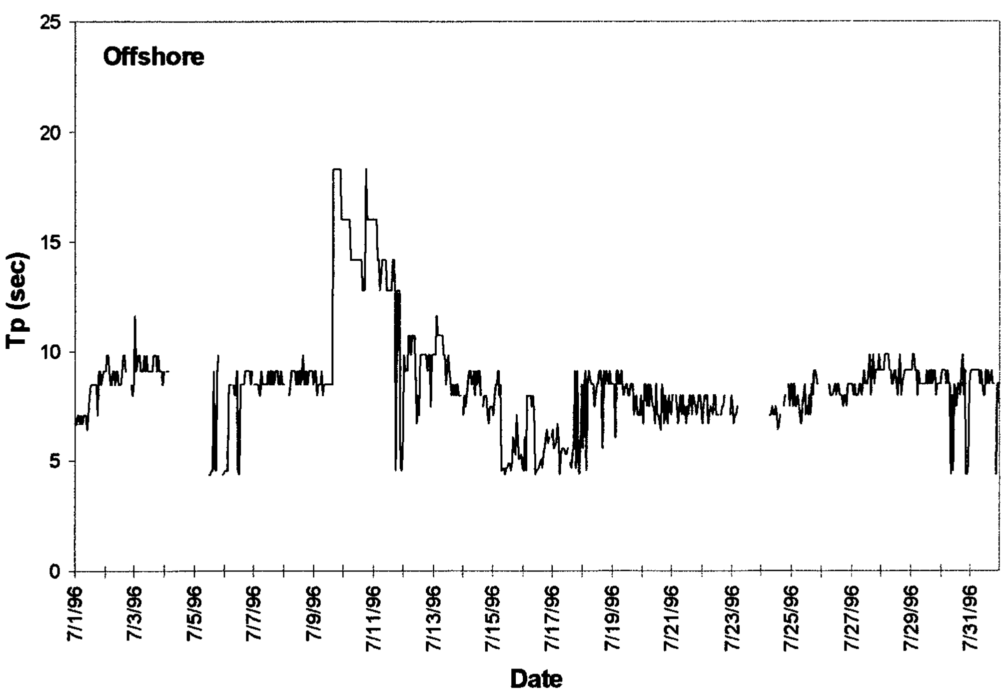

Figure 19. Peak wave period at the offshore gauge for July 1996

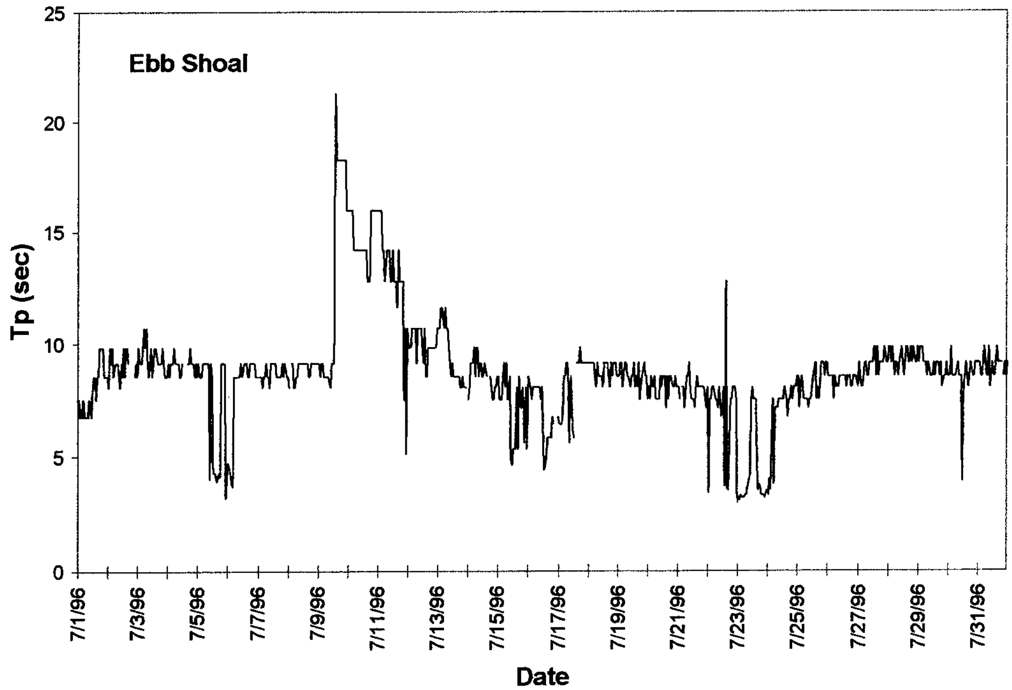

Figure 20. Peak wave period at the ebb shoal gauge for July 1996

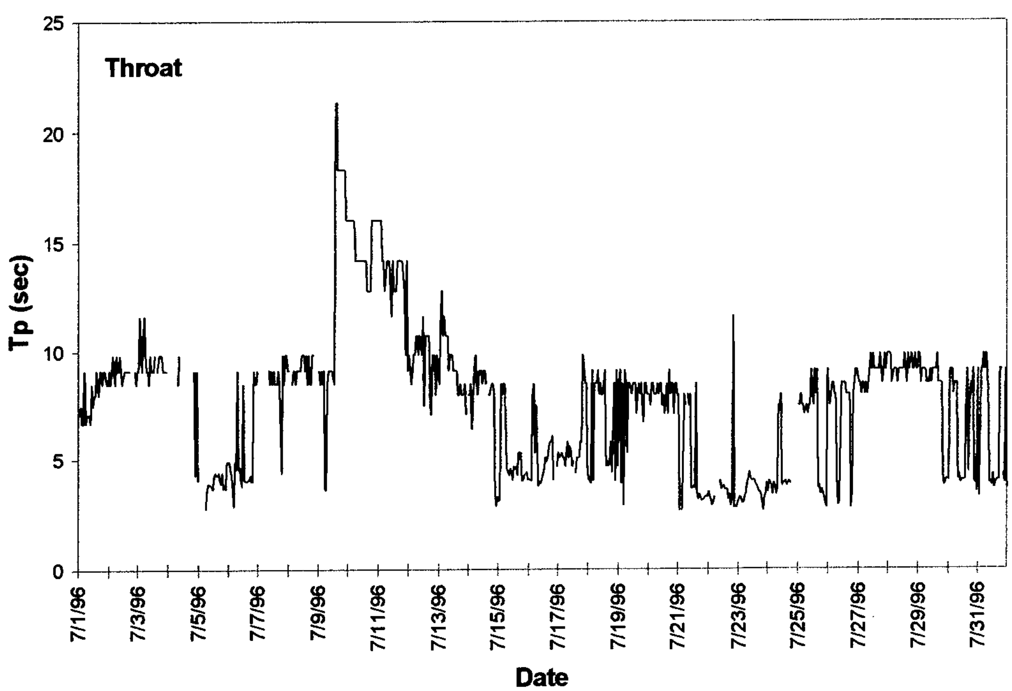

Figure 21. Peak wave period at the inlet throat gauge for July 1996

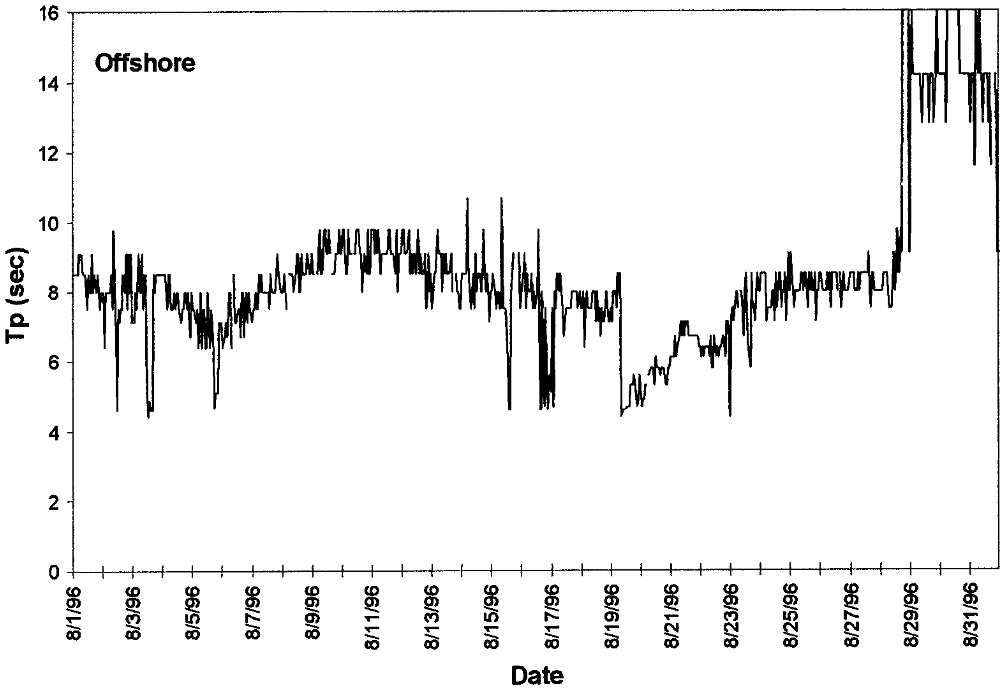

Figure 22. Peak wave period at the offshore gauge for August 1996

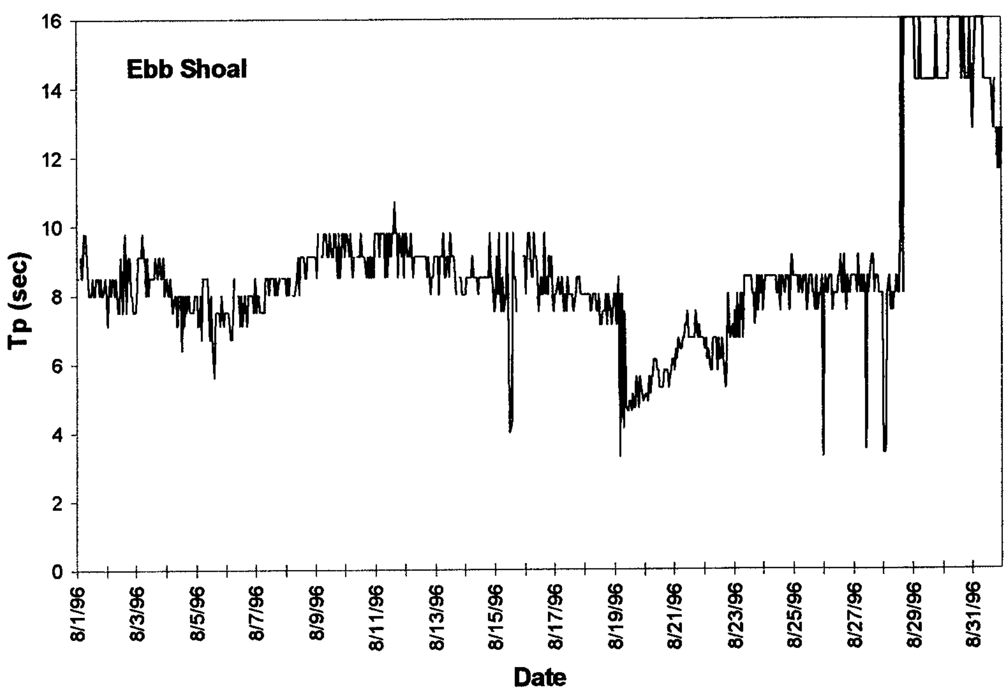

Figure 23. Peak wave period at the ebb shoal gauge for August 1996

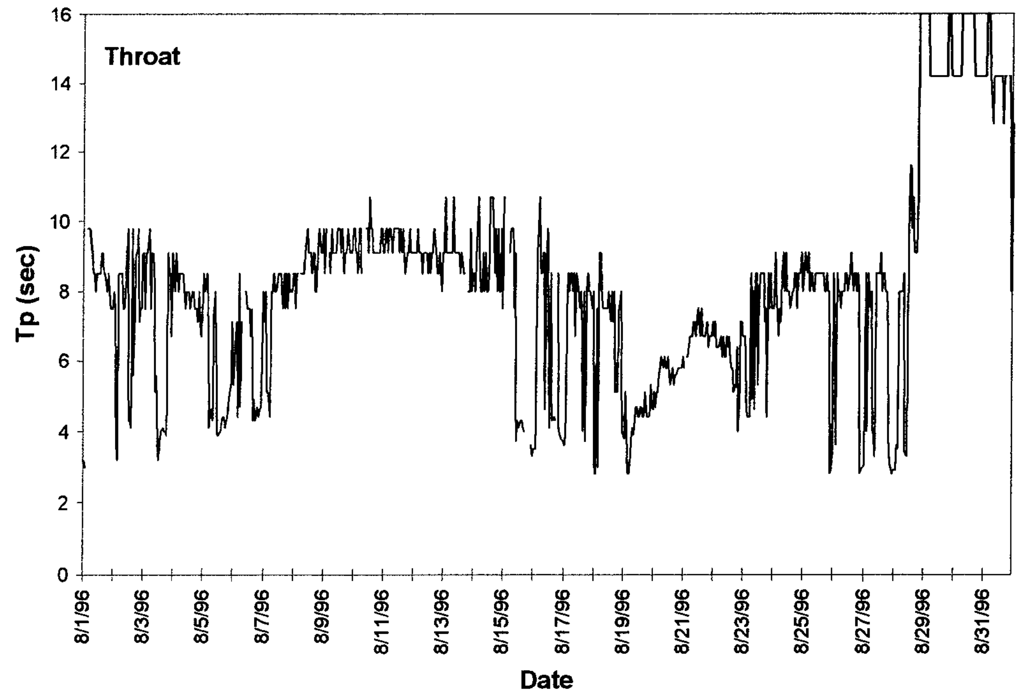

Figure 24. Peak wave period at the inlet throat gauge for August 1996

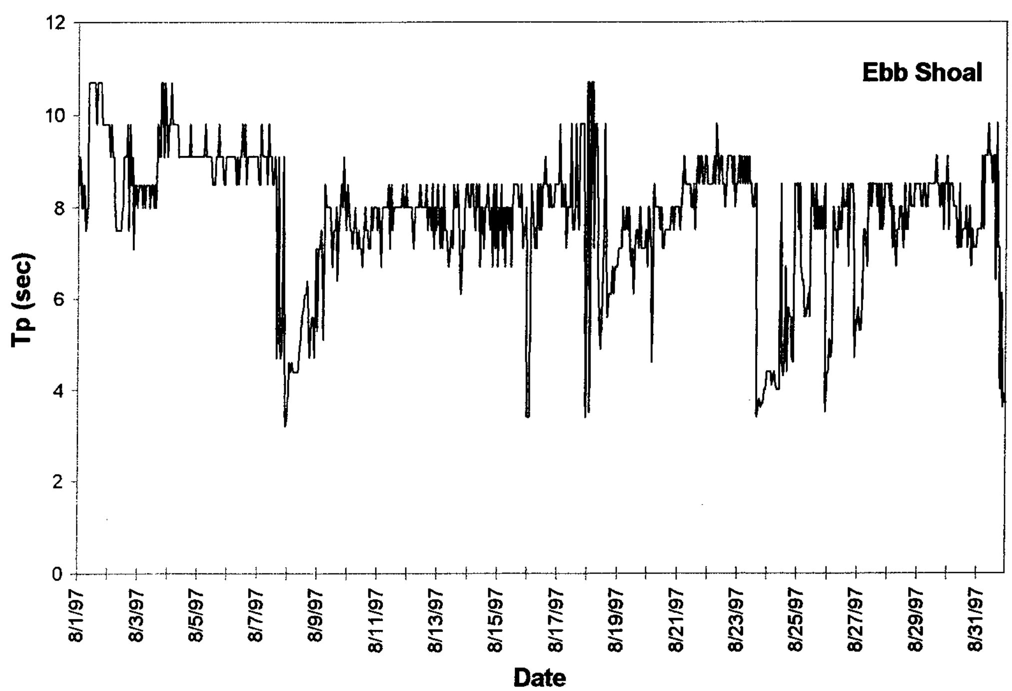

Figure 25. Peak wave period at the ebb shoal gauge for August 1997

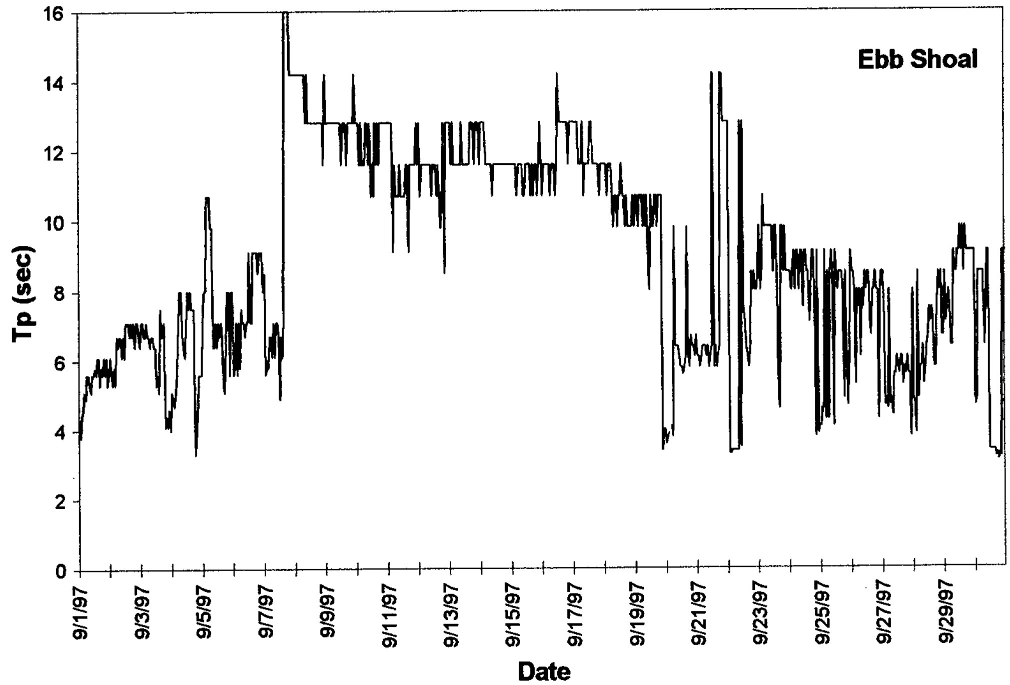

Figure 26. Peak wave period at the ebb shoal gauge for September 1997

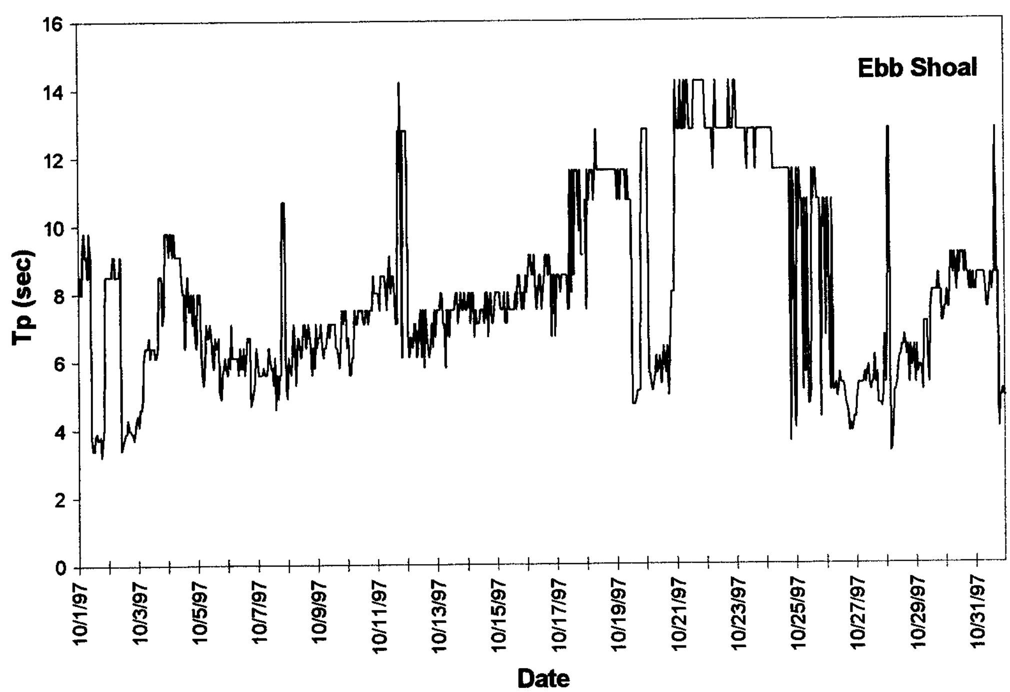

Figure 27. Peak wave period at the ebb shoal gauge for October 1997

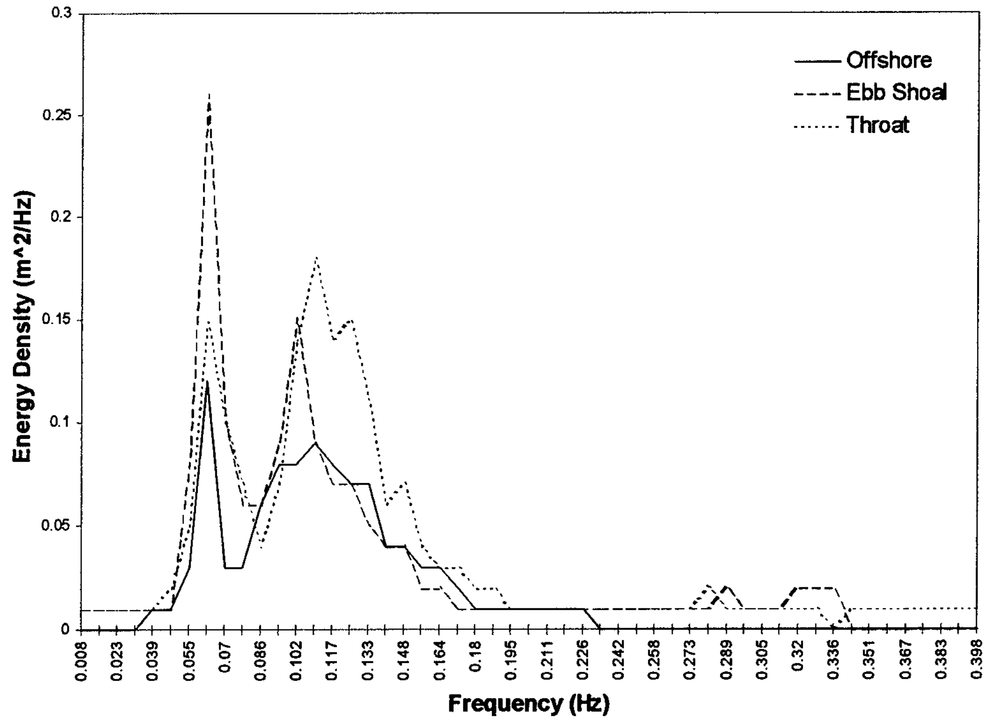

Figure 28. Frequency spectra measured at the offshore, ebb shoal, and inlet throat wave gauges on 28 August 1996 at 1800 hr GMT

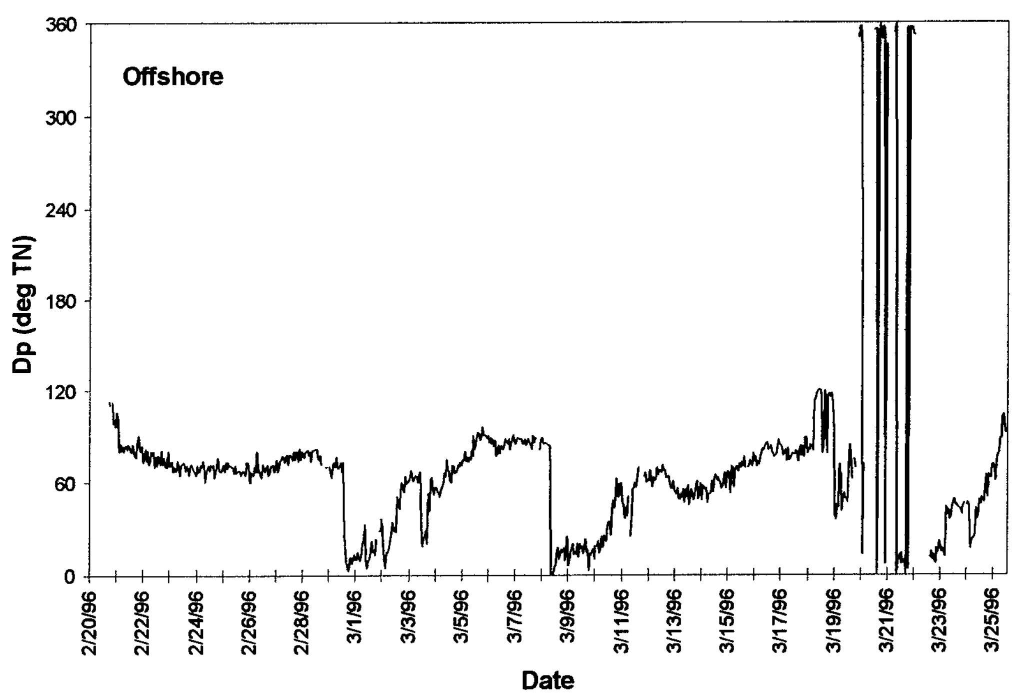

Figure 29. Peak wave direction at the offshore gauge for 20 February - 20 March 1996

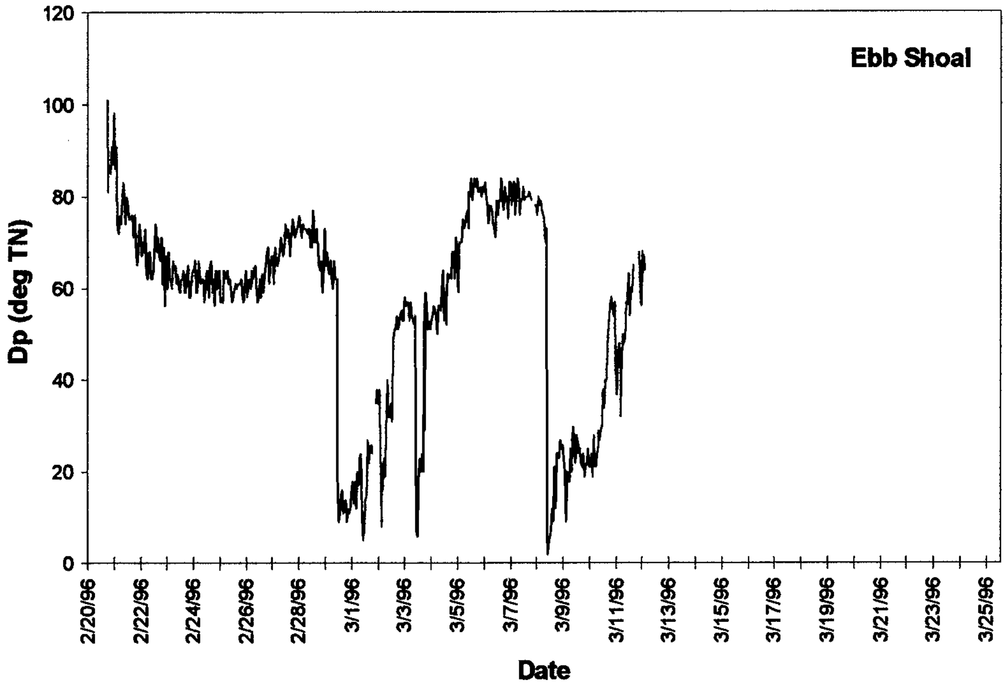

Figure 30. Peak wave direction at the ebb shoal gauge for 20 February - 20 March 1996

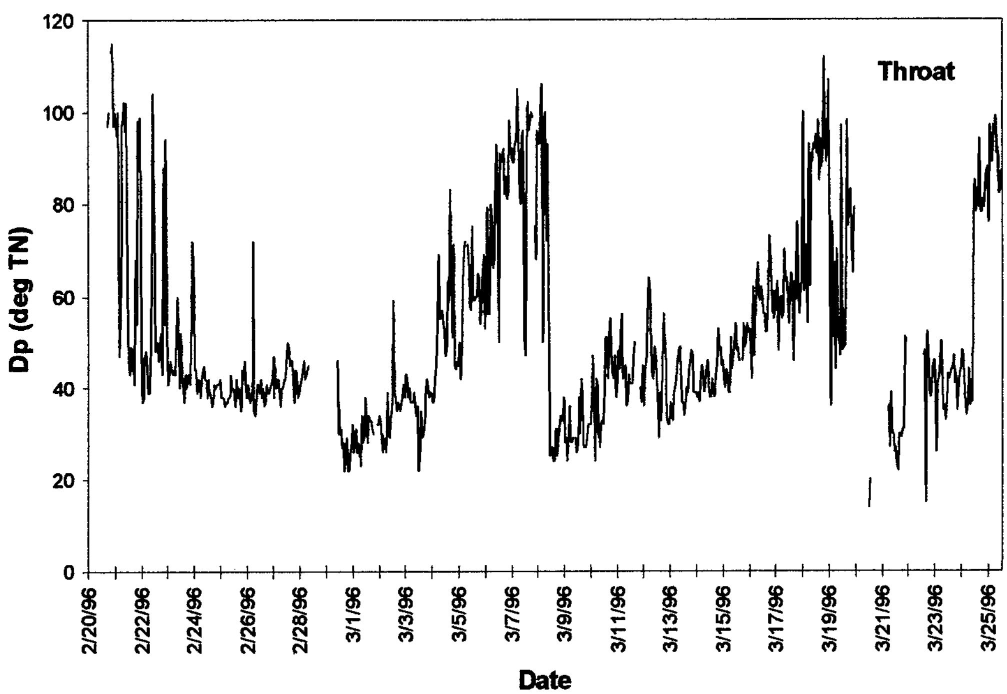

Figure 31. Peak wave direction at the inlet throat gauge for 20 February - 20 March 1996

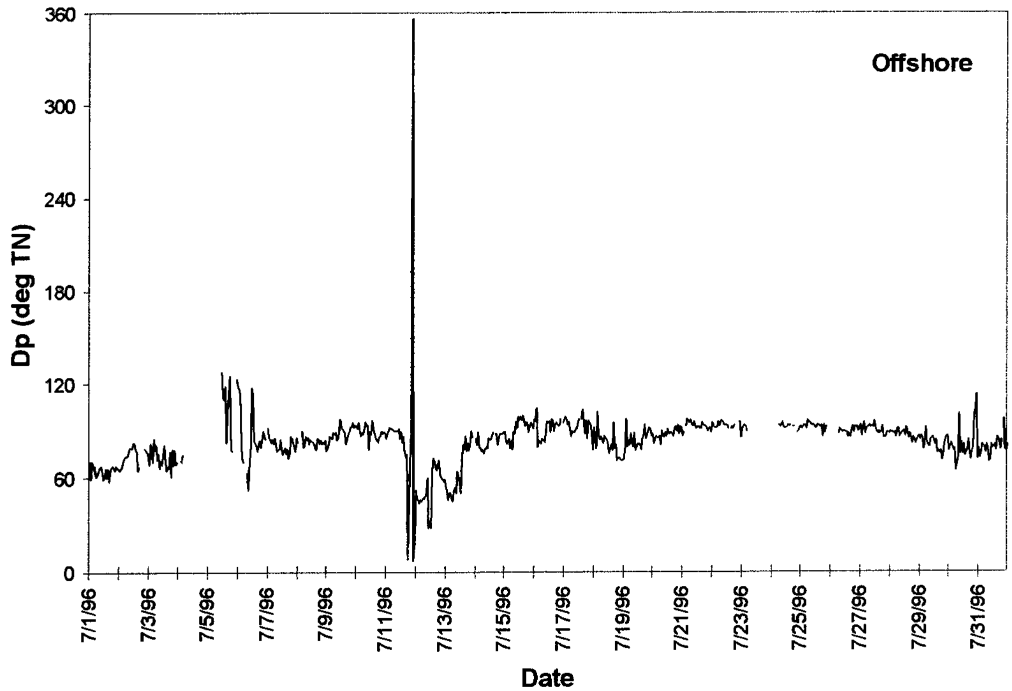

Figure 32. Peak wave direction at the offshore gauge for July 1996

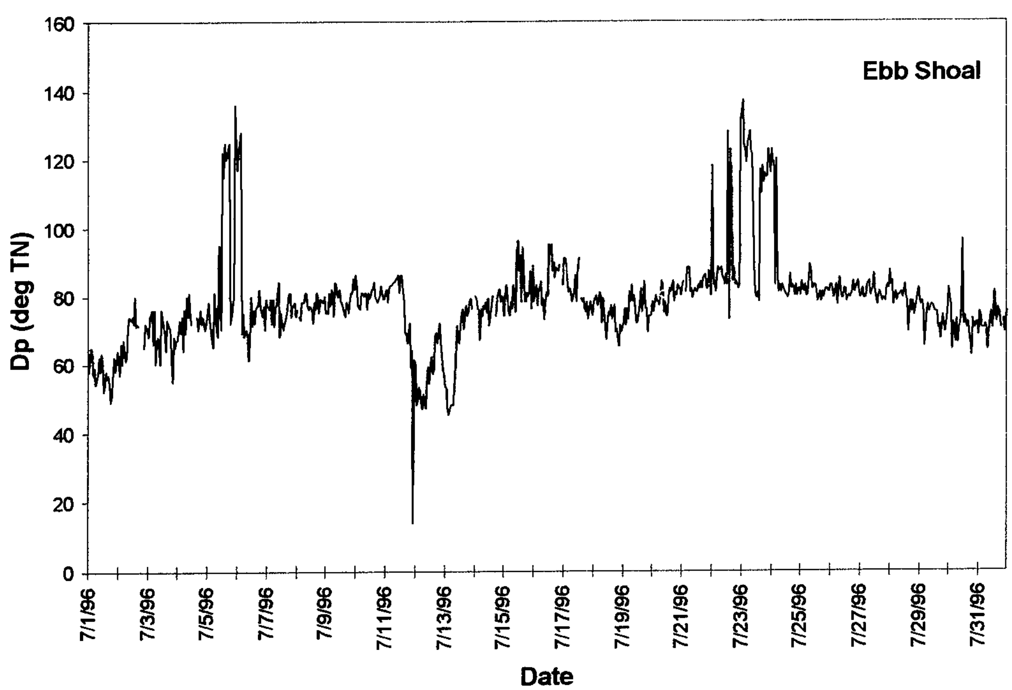

Figure 33. Peak wave direction at the ebb shoal gauge for July 1996

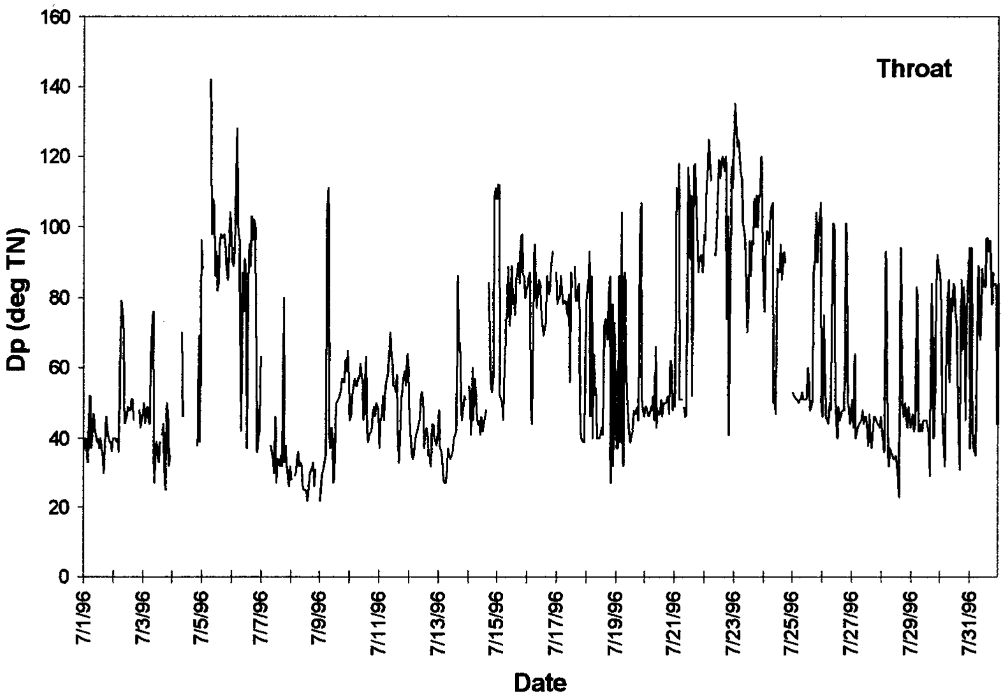

Figure 34. Peak wave direction at the inlet throat gauge for July 1996

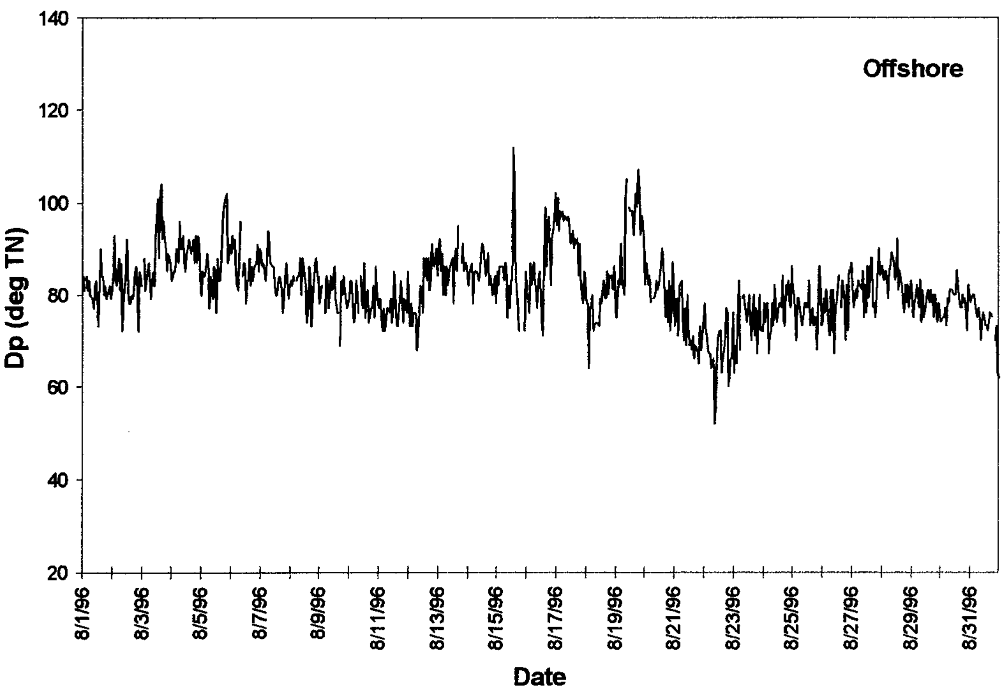

Figure 35. Peak wave direction at the offshore gauge for August 1996

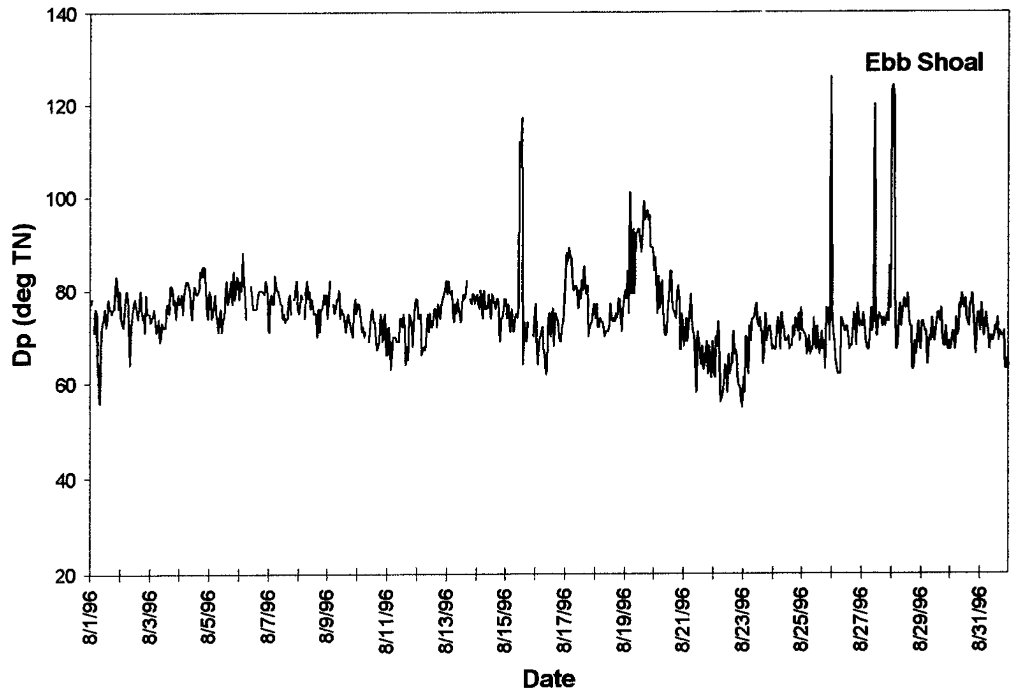

Figure 36. Peak wave direction at the ebb shoal gauge for August 1996

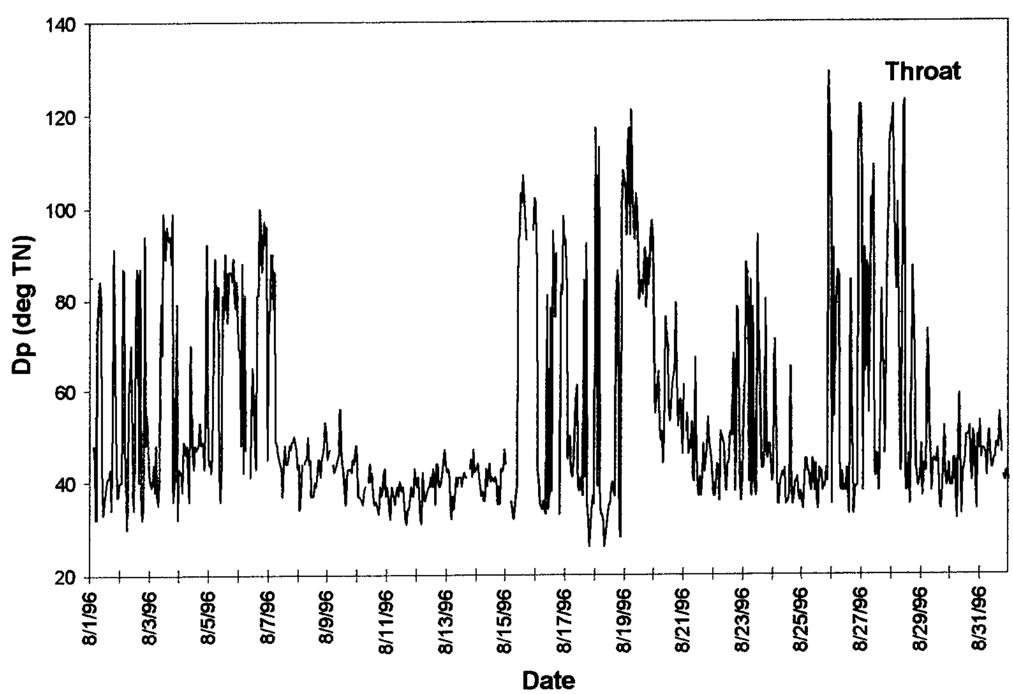

Figure 37. Peak wave direction at the inlet throat gauge for August 1996

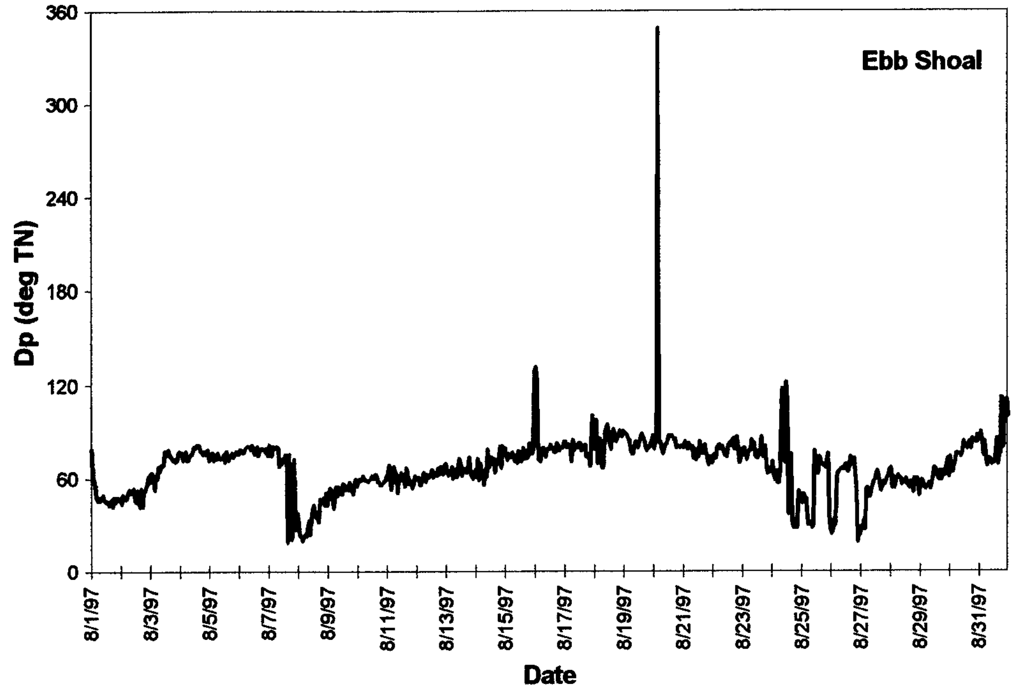

Figure 38. Peak wave direction at the ebb shoal gauge for August 1997

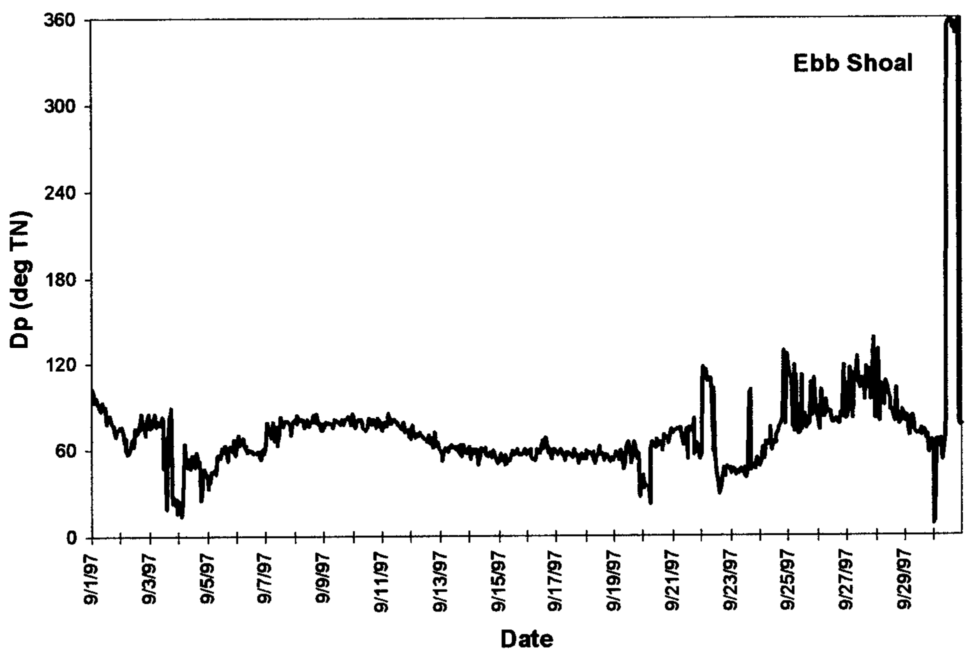

Figure 39. Peak wave direction at the ebb shoal gauge for September 1997

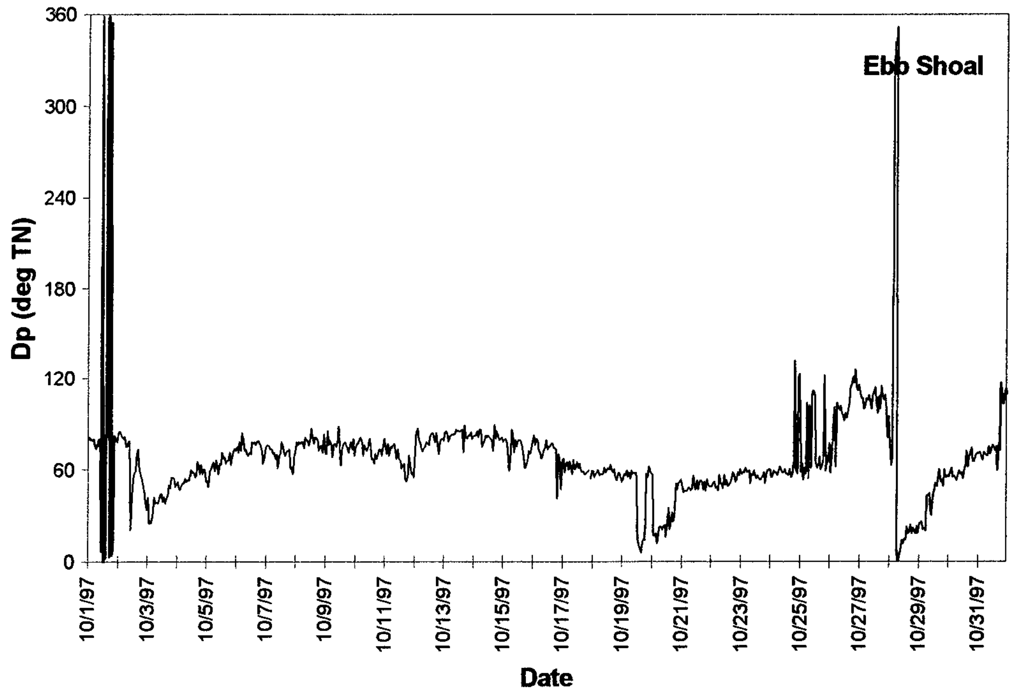

Figure 40. Peak wave direction at the ebb shoal gauge for October 1997

Water Level Results

Water level data were collected at 6-min intervals at seven sites in the region of Ponce de Leon Inlet. Two sites, offshore (DWG1INT1) and ebb shoal (DWG1EBB1), were located in the coastal ocean; one site was located in the outer throat of the inlet (DWG1OTH1); and four sites, river north (SPRSBAY1), river west (SPRSBAY2), river south (SPRSBAY3), and Coast Guard station (VITLBAY3), were located in the back bay (see Figure 3 and Table 1). The regional coverage provides information on the tide wave and storm surge as they propagate through the inlet and into the back-bay channels. The data coverage also allows for hydrodynamic model calibration in the vicinity of the inlet. These data are plotted in Figures 41-53.

Figures 41-43 show the water levels offshore, at the ebb shoal, and at the inlet throat for the time period 7-19 March 1996 (Julian days 67-79). A storm passed through the study site during this time and elevated the water level for approximately 3 days (Julian days 71-73). The increase in coastal ocean water level was approximately 0.3 m. In the back bay, the superelevation was approximately twice that amount at 0.6 - 0.7 m (Figures 44-47).

The storm that passed through the study area on 12 July 1996 (Julian Day 194) elevated the ocean water level by approximately 0.3 m (Figures 48-50), whereas in the back bay the water rose approximately 0.4 m above the pre-storm water level (Figures 51-53). The July/August data also provide information on the variation of the tidal range over a spring-neap cycle. During the neap tide, the tidal range is approximately 0.7 m, whereas during the spring tide, the tidal range is approximately 1.3 m. The monthly variation in water level is expected to induce corresponding changes in current velocity in the inlet throat.

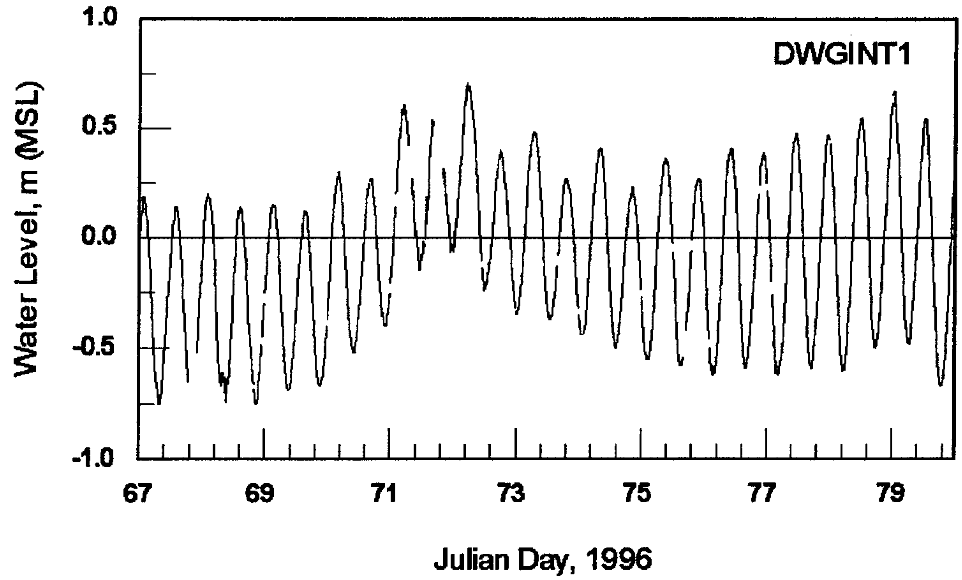

Figure 41. Water level at offshore gauge for 7 March (JD 67) - 19 March 1996

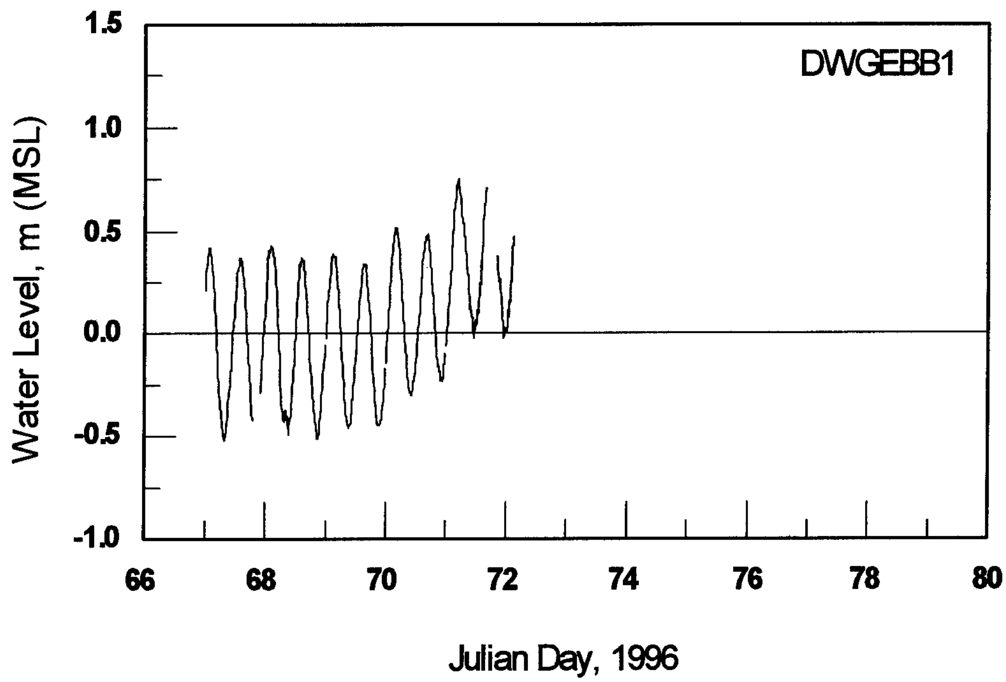

Figure 42. Water level at ebb shoal gauge for 7 March (JD 67) - 19 March 1996

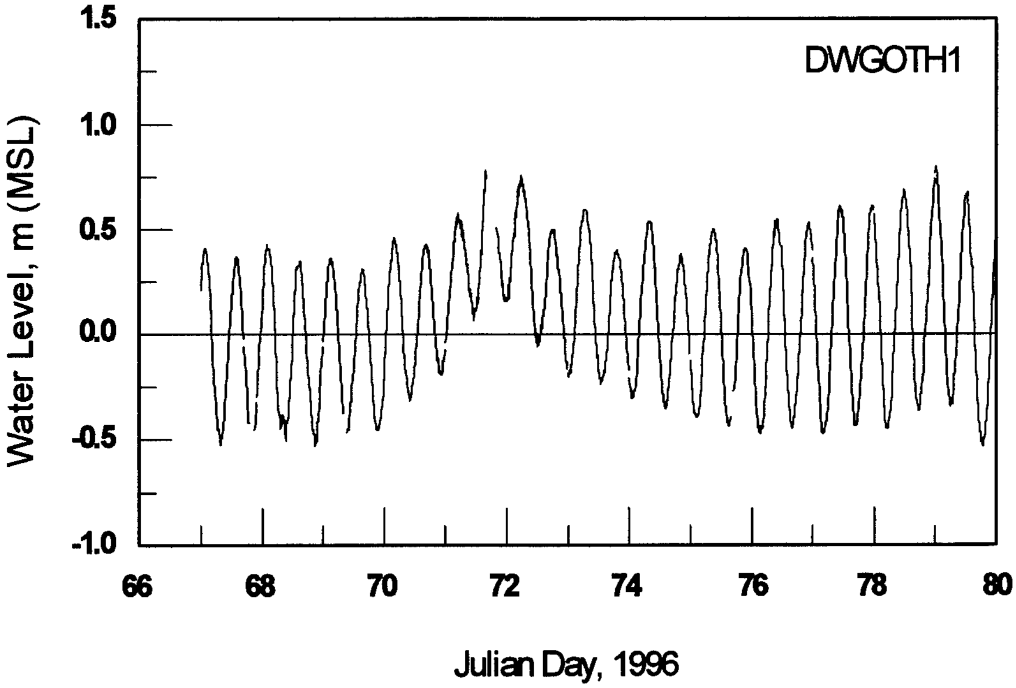

Figure 43. Water level at inlet throat gauge for 7 March (JD 67) - 19 March 1996

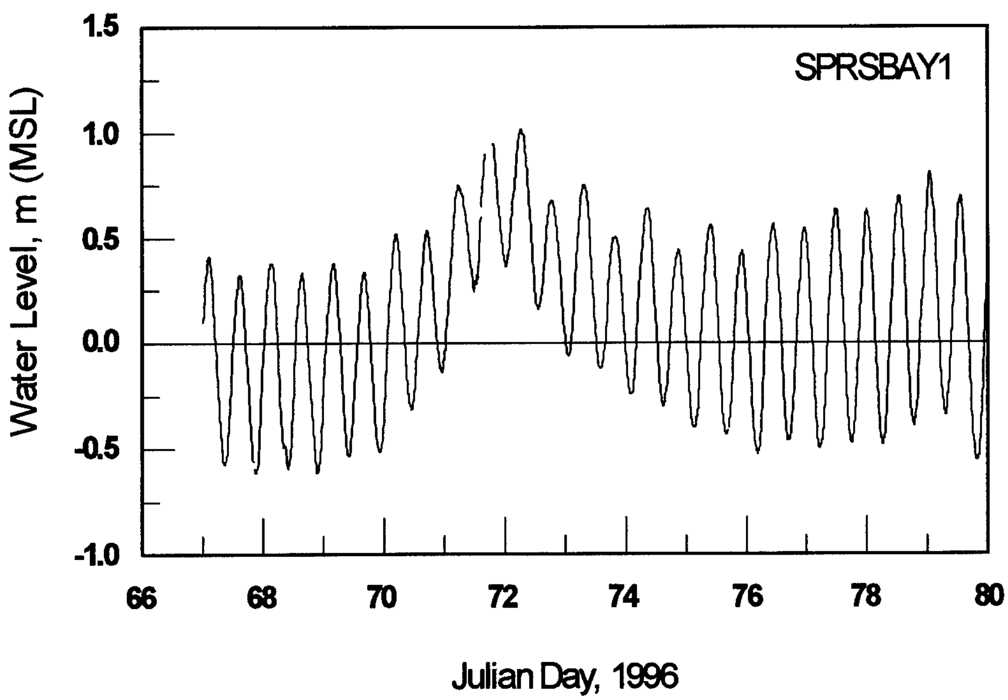

Figure 44. Water level at river north gauge for 7 March (JD 67) - 19 March 1996

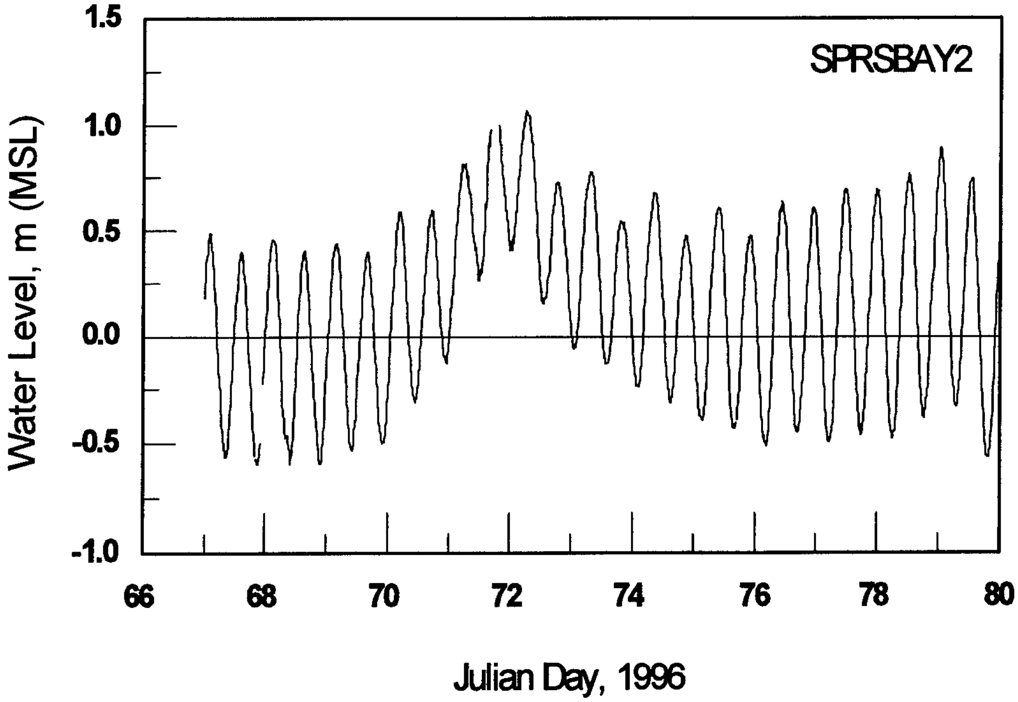

Figure 45. Water level at river west gauge for 7 March (JD 67) - 19 March 1996

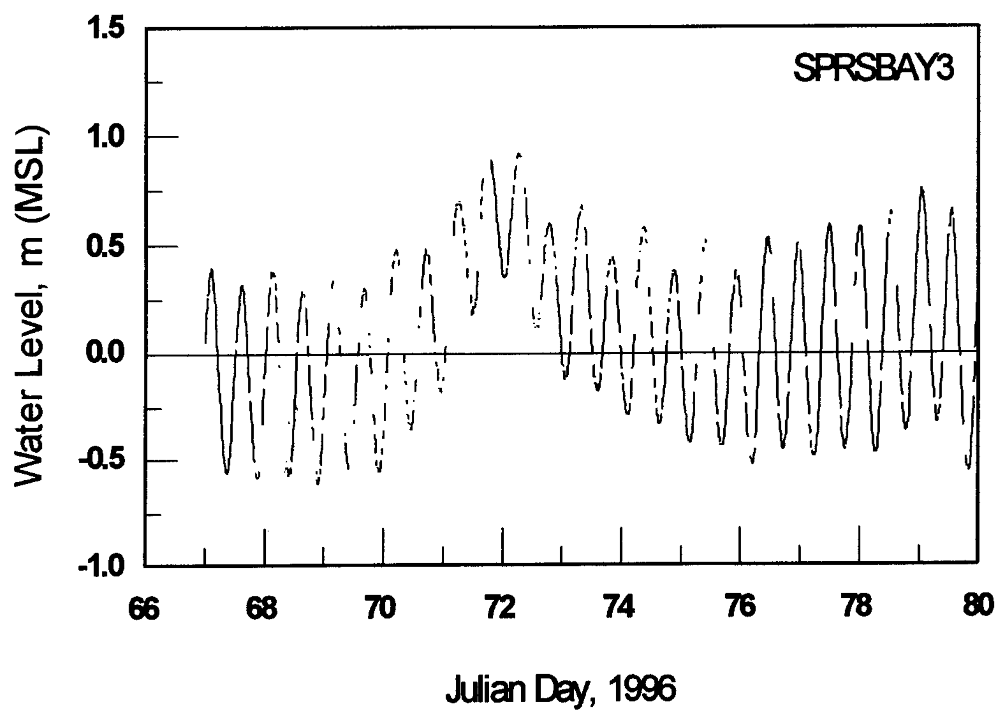

Figure 46. Water level at river south gauge for 7 March (JD 67) - 19 March 1996

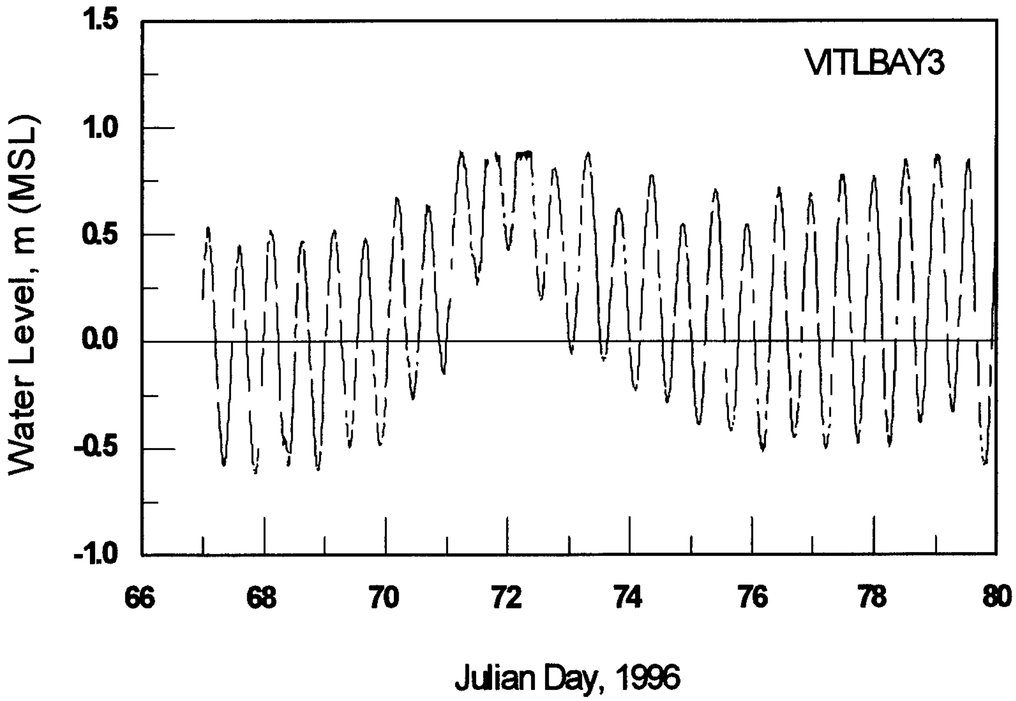

Figure 47. Water level at Coast Guard station gauge for 7 March (JD 67) - 19 March 1996

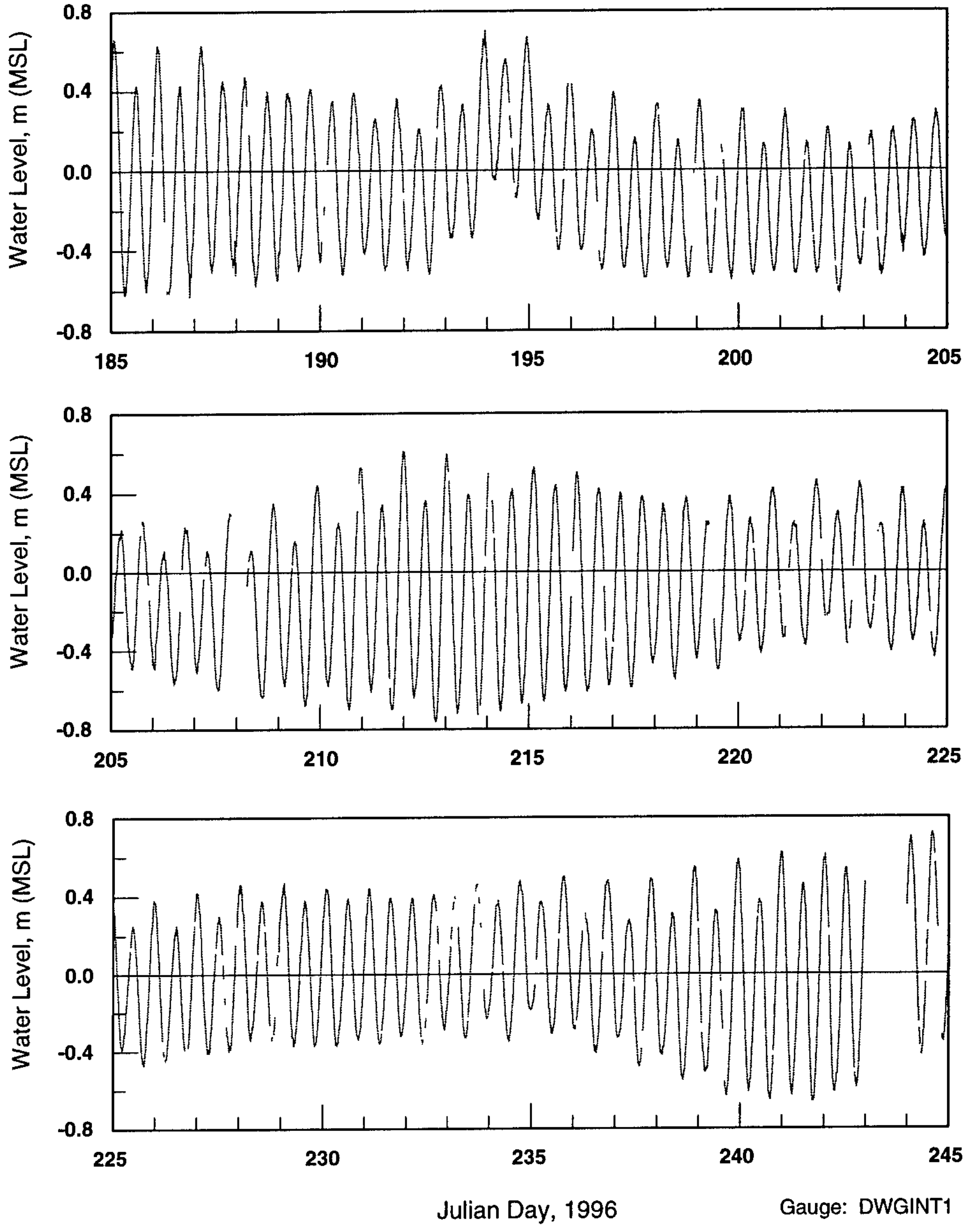

Figure 48. Water level at offshore gauge for 3 July (JD 185) - 31 August 1996

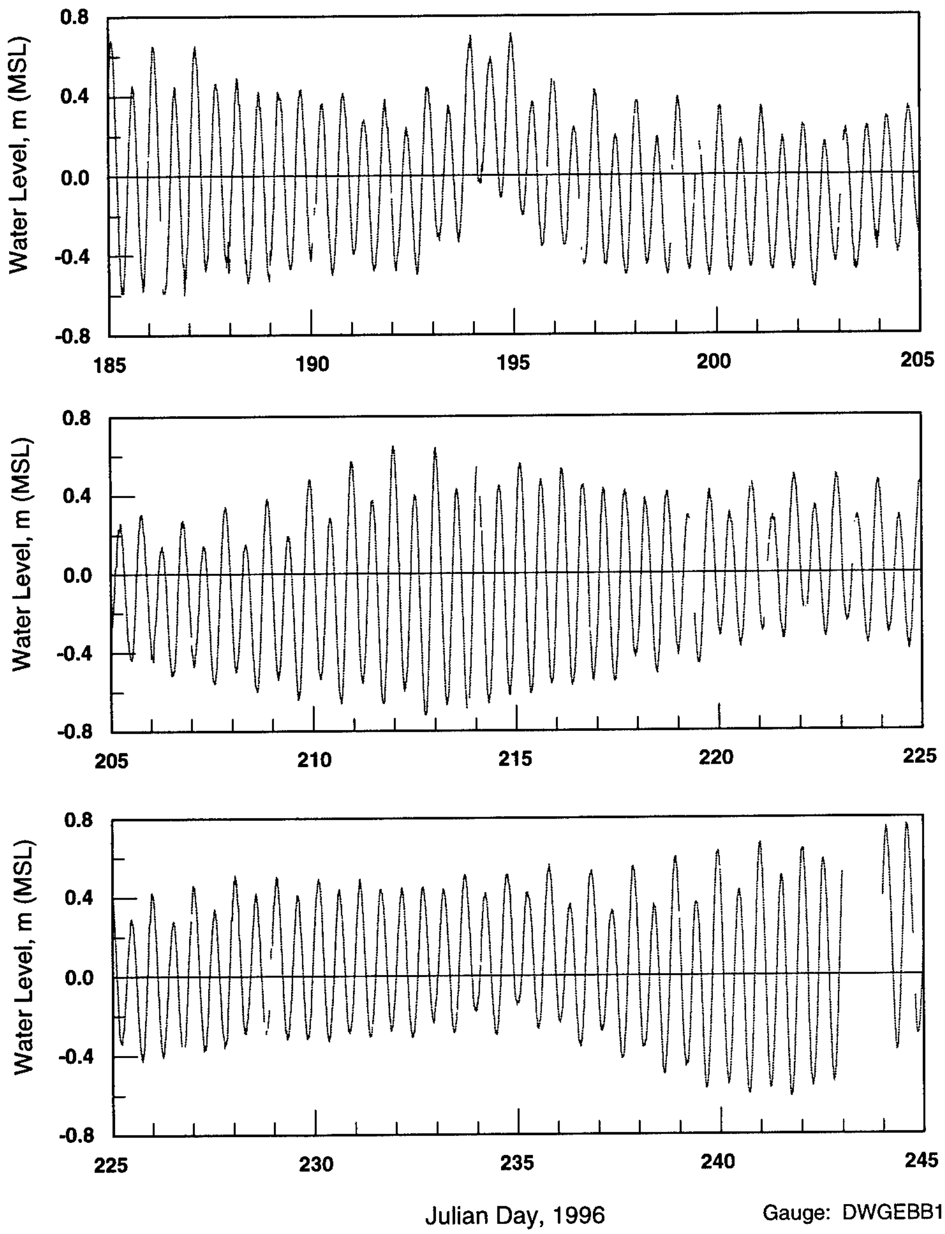

Figure 49. Water level ebb shoal gauge for 3 July (JD 185) - 31 August 1996

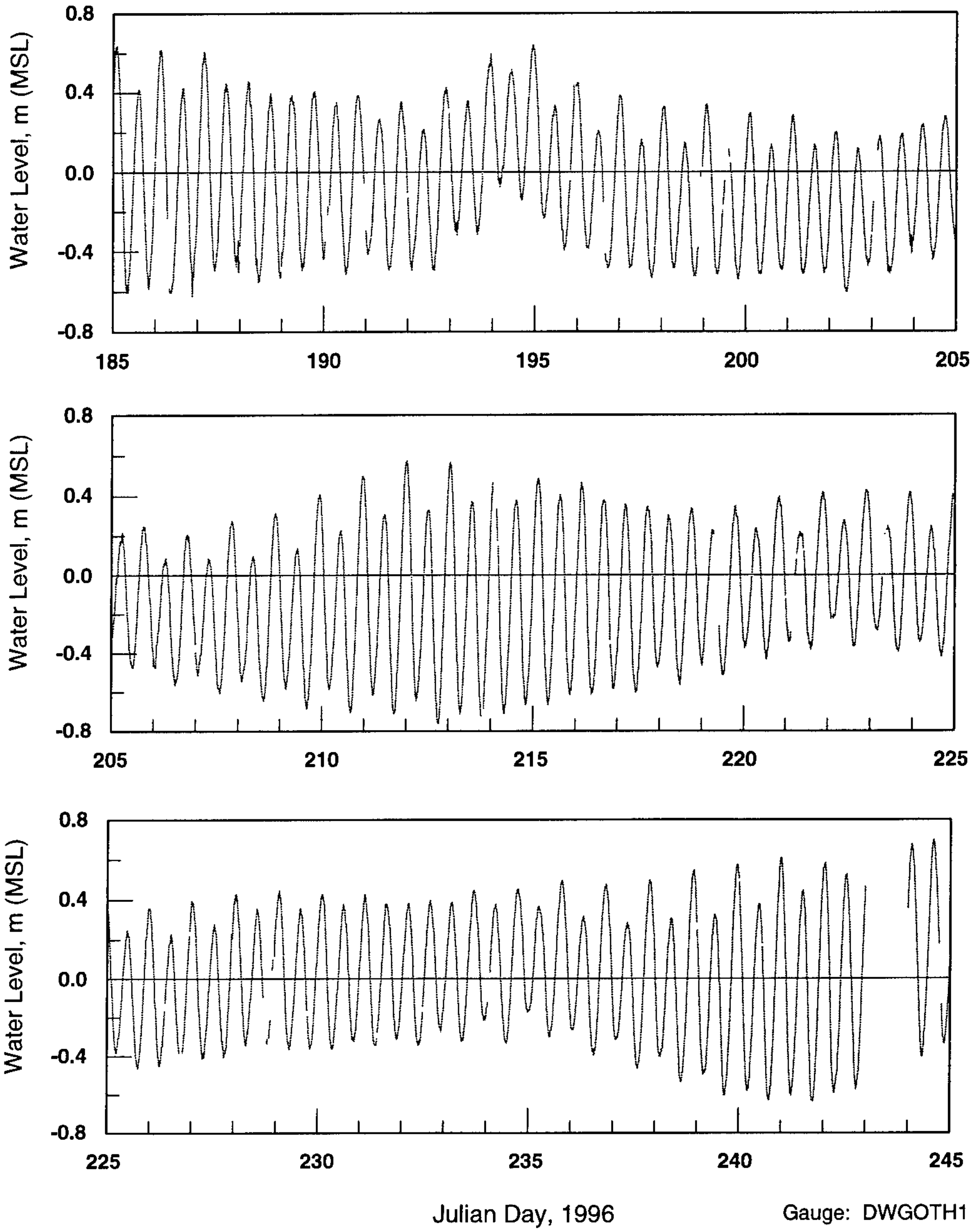

Figure 50. Water level at inlet throat gauge for 3 July (JD 185) - 31 August 1996

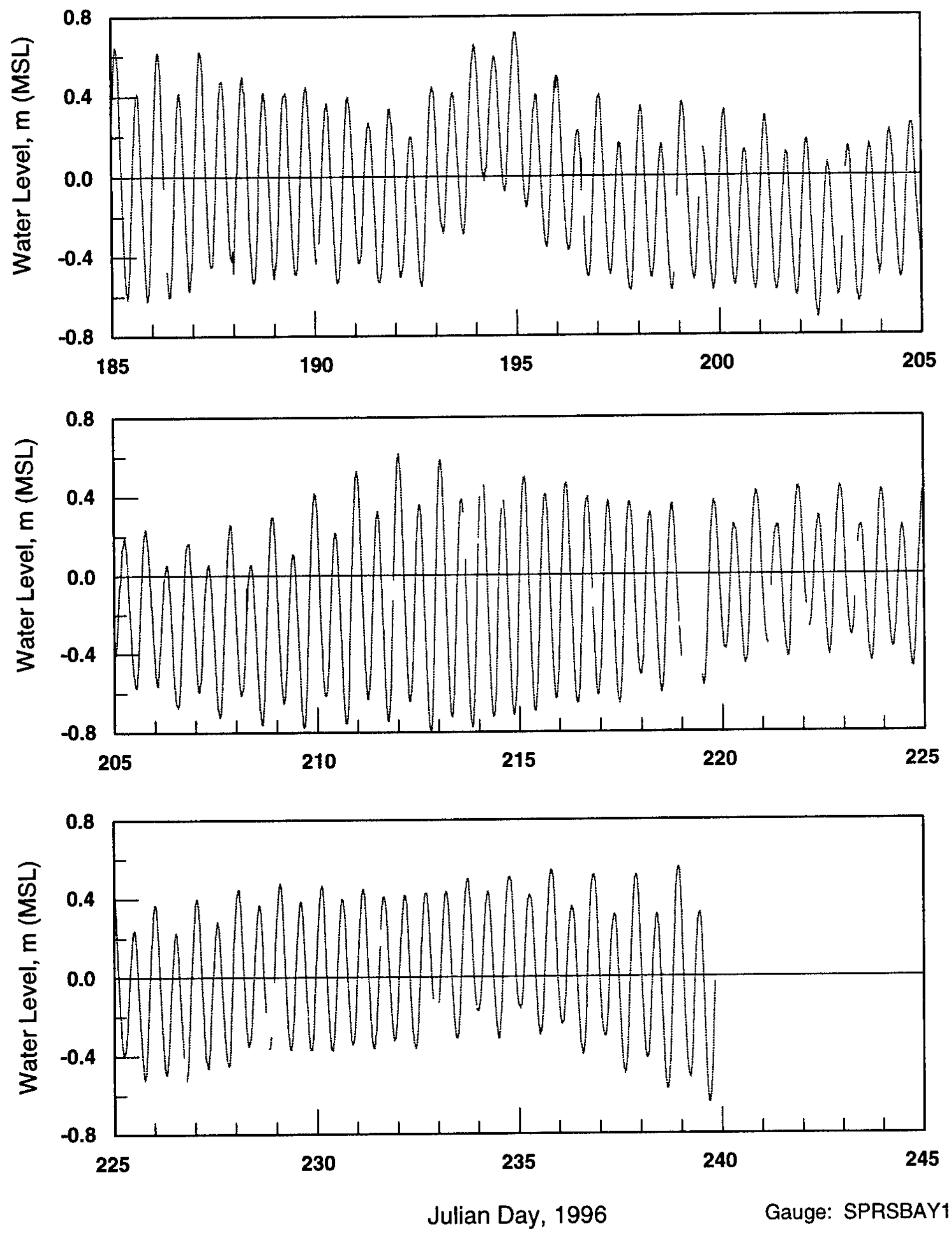

Figure 51. Water level at river north gauge for 3 July (JD 185) - 31 August 1996

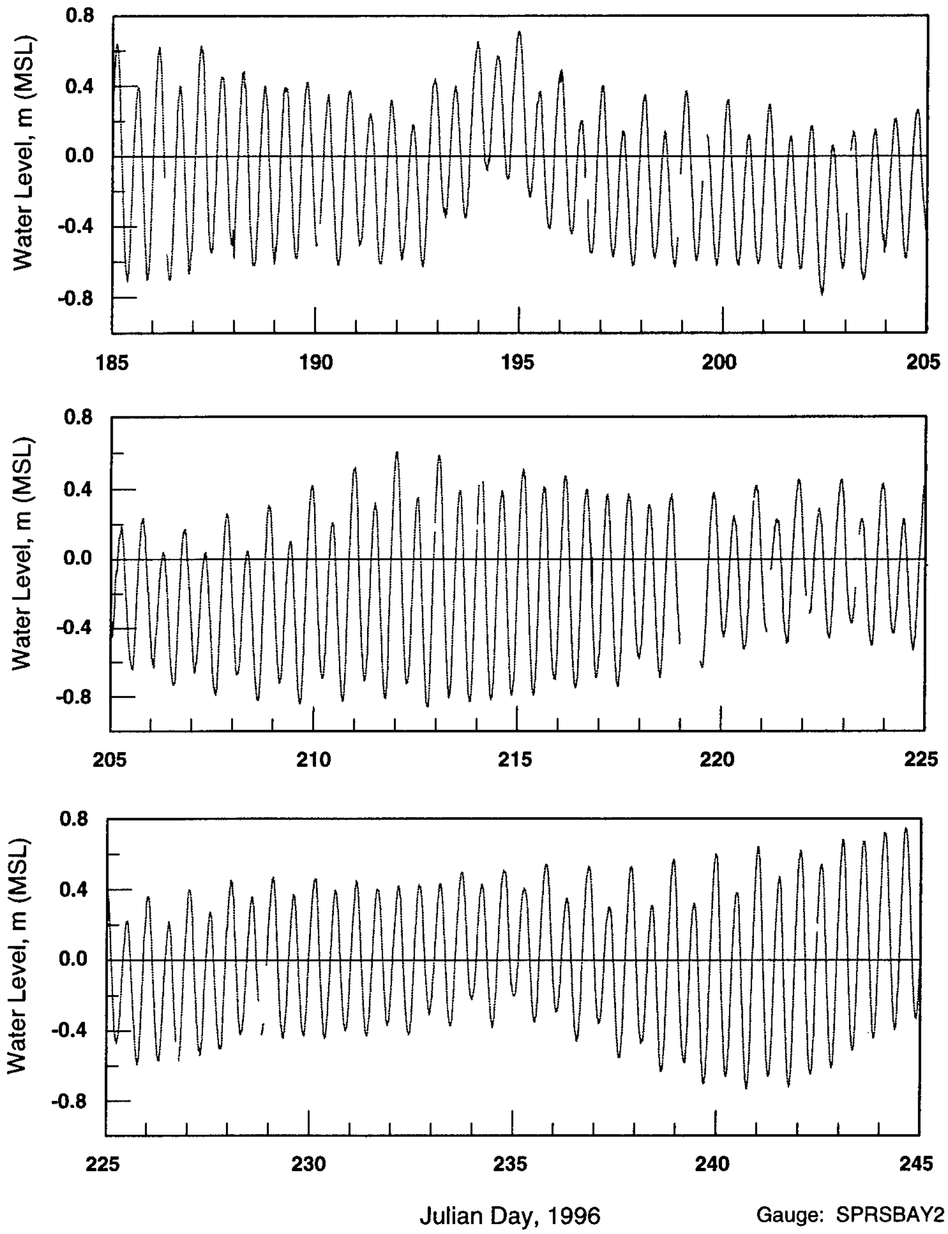

Figure 52. Water level at river west gauge for 3 July (JD 185) - 31 August 1996

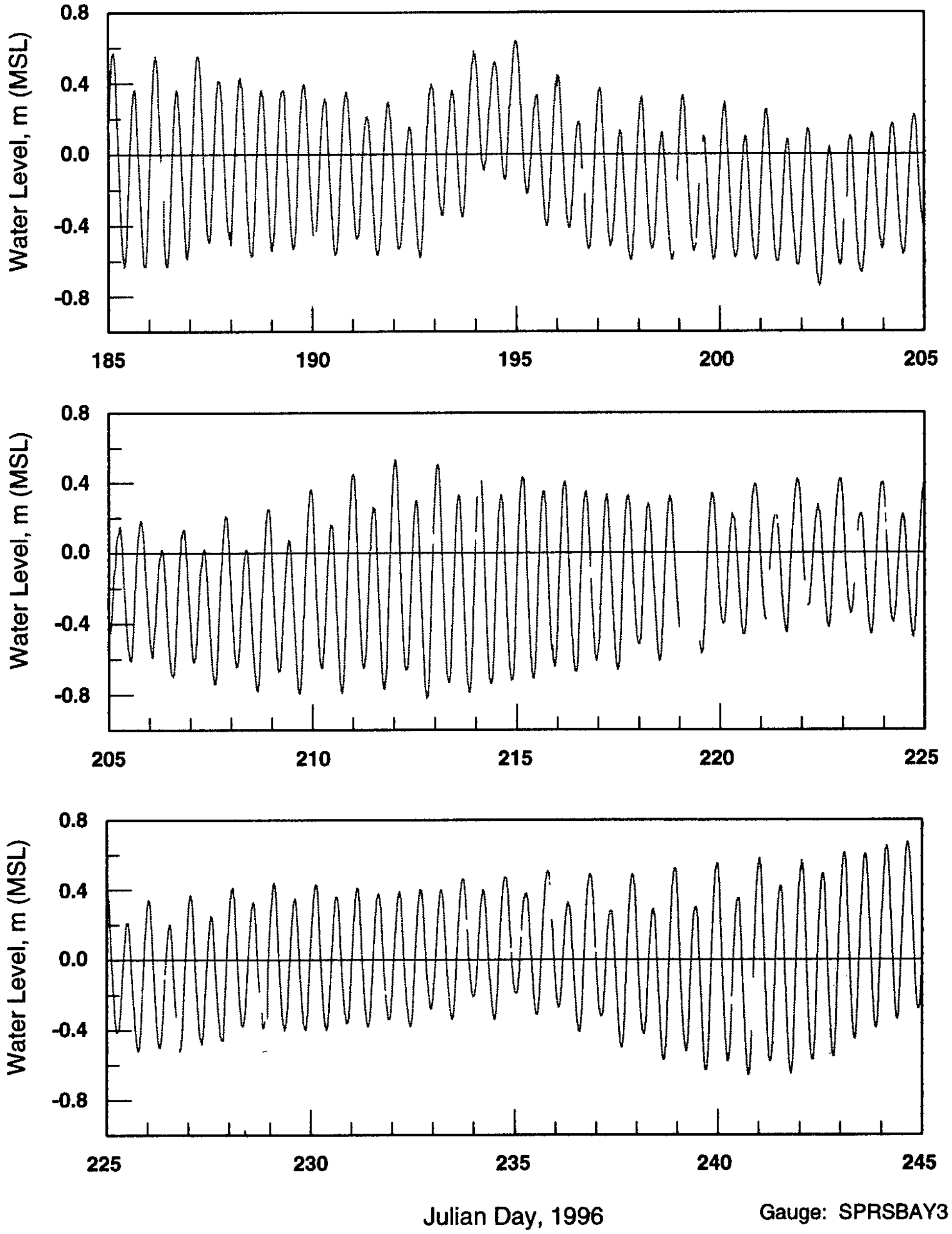

Figure 53. Water level at river south gauge for 3 July (JD 185) - 31 August 1996

Current Results

Currents were measured in the inlet throat and on the outer edge of the ebb shoal, at Sites B and C (see Figure 3). During the three periods of interest, current data were only available for July and August 1996. The north/south and east/west components of these currents are shown in Figures 54-57. Positive values indicate north and east for each component. During the 12 July storm (Julian Day 195), the north-south component of the current at the inlet gauge (Figure 54) flowed southward, indicating the wind and wave-driven alongshore current for about 2 days. During a typical tidal cycle, peak inlet throat currents reached approximately 0.8 m/sec, but current speed was measured as strong as 1.3 m/sec during the spring tide on 29 August (Julian Day 242, Figure 55). In general, the currents at this location exhibit ebb dominance.

Currents measured at the ebb shoal gauge are reduced in magnitude as compared with those measured at the inlet throat. In addition, on the ebb shoal, the north-south and east-west components are generally of equal magnitude; whereas in the inlet throat, the current was directed predominantly along an east-west axis (aligned with the inlet). During the storm of 12 July (Julian Day 195), the ebb shoal data showed a strong current reaching 1.2 m/sec toward the south and comparatively unorganized current motion in the east-west component (Figure 56). This signal indicates a strong southward wave-driven flow that dominated the current and suppressed the tidal current through the inlet. Two other south flowing events occurred in August (Figure 57).

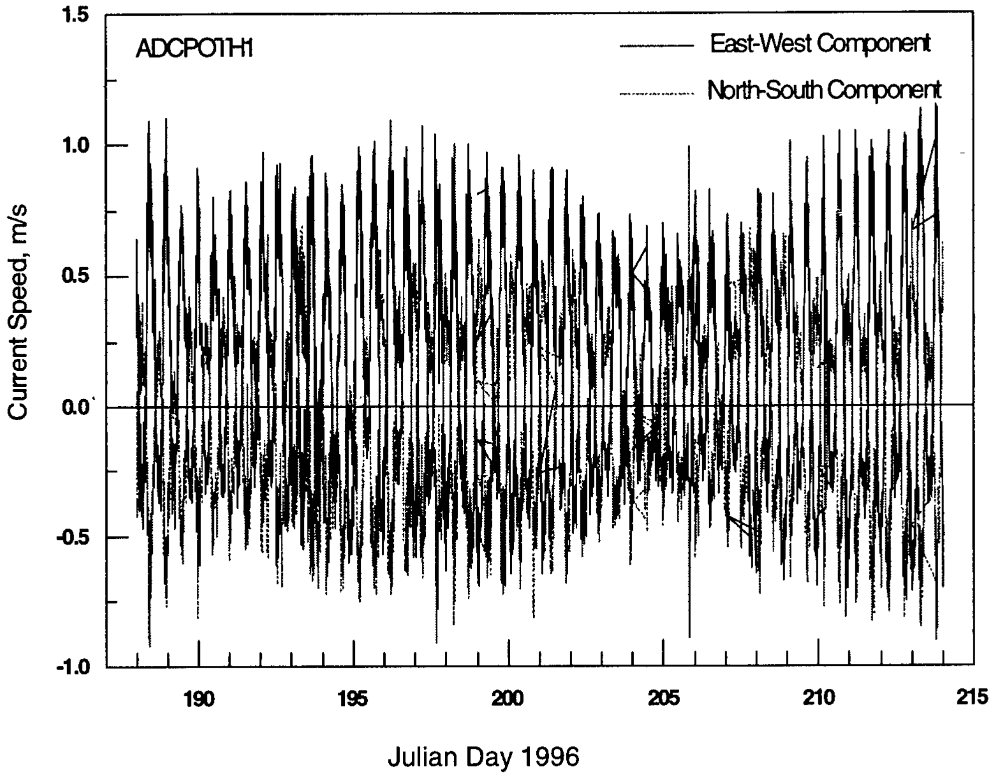

Figure 54. Current at inlet throat gauge for 5 July (JD 188) - 1 August 1996

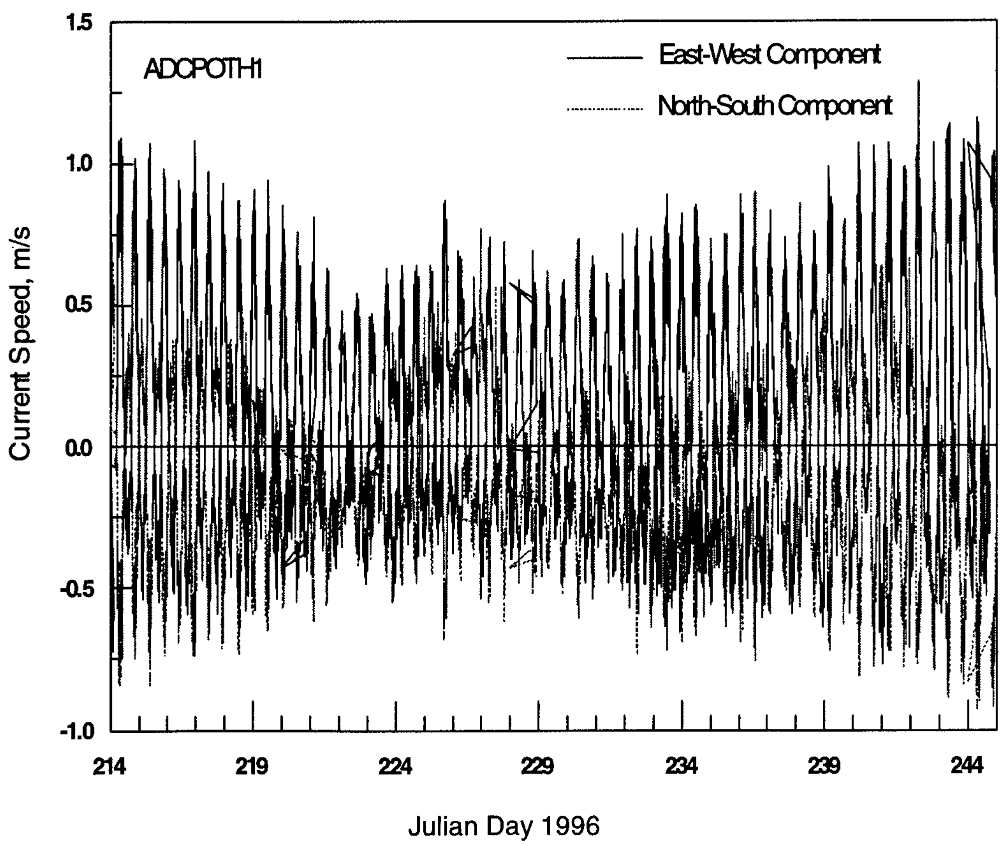

Figure 55. Current at inlet throat gauge for 1 August (JD 214) - 31 August 1996

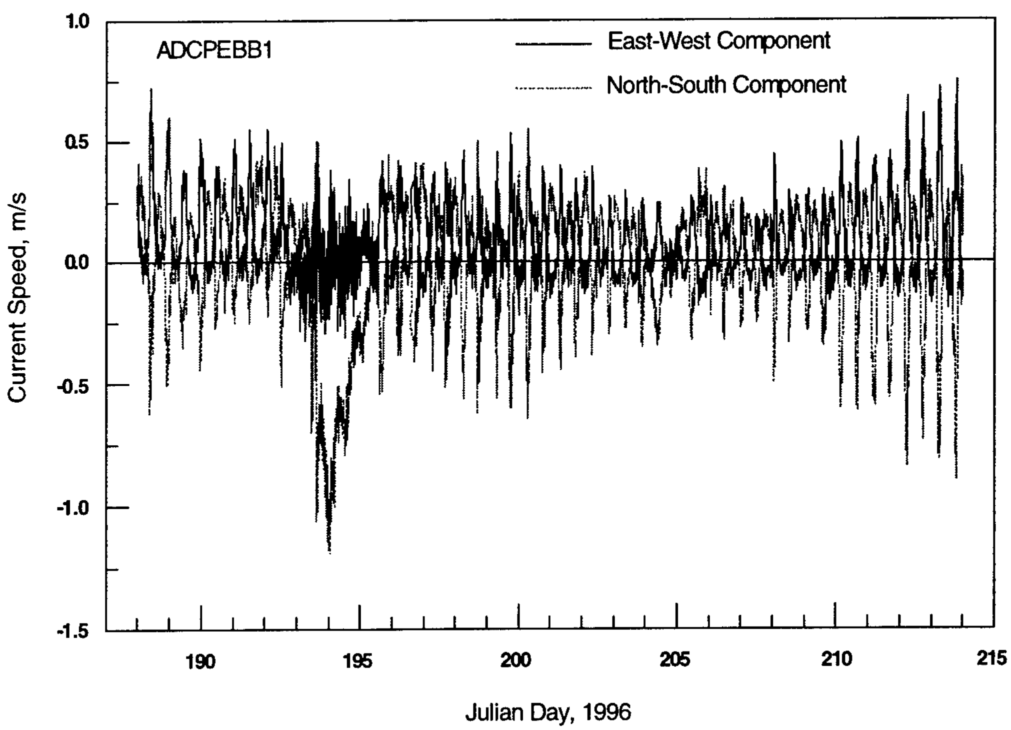

Figure 56. Current at ebb shoal gauge for 5 July (JD 188) - 1 August 1996

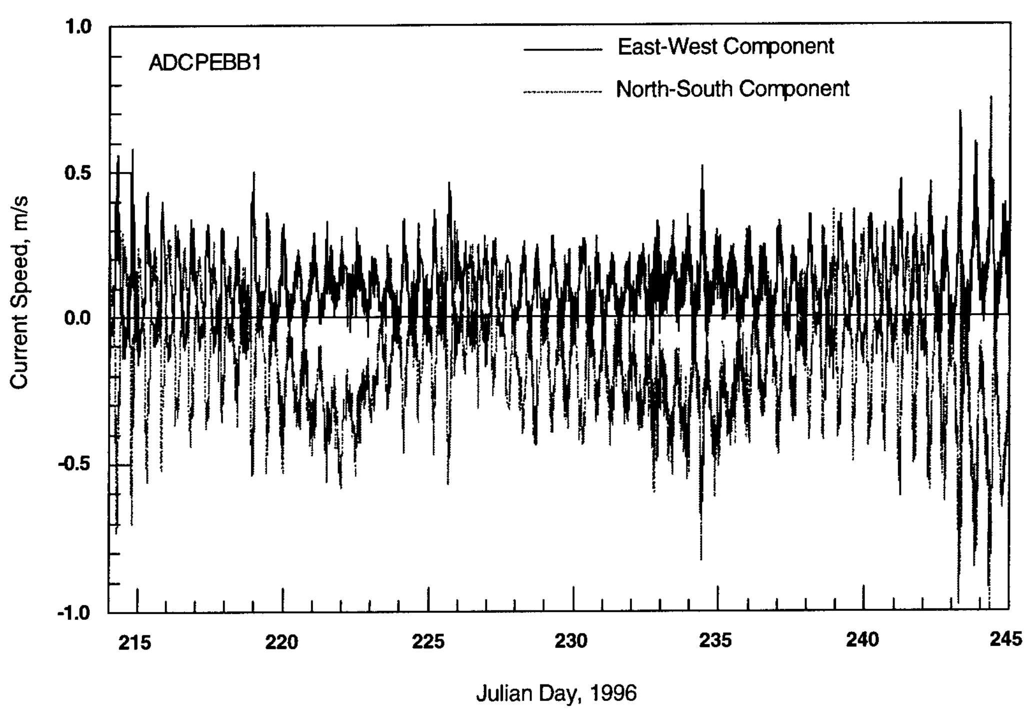

Figure 57. Current at ebb shoal gauge for 1 August (JD 214) - 1 September 1996

Wind Results

Wind measurements are of interest at coastal inlets because the winds can force longshore and cross-shore currents, storm surge, local wave generation, and wind-blown sand transport. Plots of the measured wind speed at the Battelle gauge (Site H in Figure 3) for the months of February/March 1996, July 1996, August 1996, August 1997, September 1997, and October 1997 are given in Figures 58-63; and directions for the same months are given in Figures 64-69. In the March 1996 wind speed plot (Figure 58), the most prominent feature is the high winds associated with the storm event that peaks on 11 March. The wind speed peaks early on 11 March at 16 m/sec and then peaks again 22 hr later at 17 m/sec. During the 11 March storm, strong winds from the north were sustained over 3 days, which generated 5.4-m waves. In July and August 1996, the maximum wind speeds measured were 8 m/sec (Figures 59 and 60). An event on 11 July had winds from the north, and an event on 21 August had east-northeast winds over a 5-day period (Figures 65 and 66).

The wind speed has a strong 24-hr cycle, with the maximum wind speed typically occurring between 1700 and 2100 GMT (1200-1600 Eastern Standard Time (EST), 1300-1700 Eastern Daylight Time (EDT)) and the minimum wind speed occurring between 0500 and 0900 GMT (0000-0400 EST, 0100-0500 EDT). During this daily cycle, the maximum winds typically blow onshore and the minimum winds blow offshore. This is a typical sea breeze and land breeze cycle caused by the warming of the land during the day and cooling at night. The diurnal shift in direction is shown in the wind direction plots (Figures 64-69).

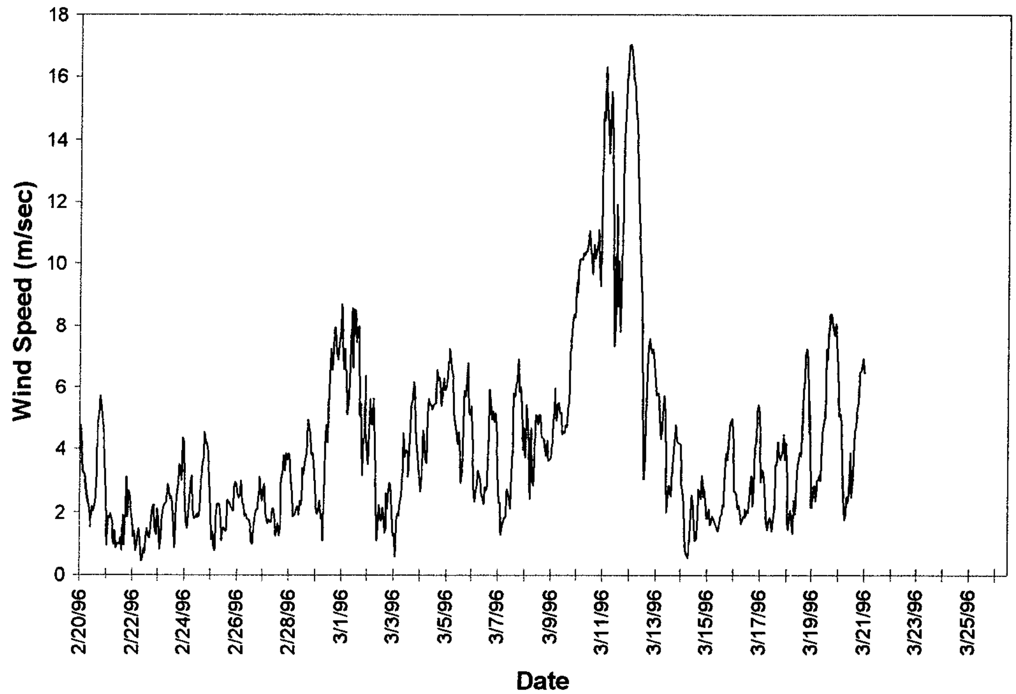

Figure 58. Wind speed at the Battelle site for 20 February - 20 March 1996

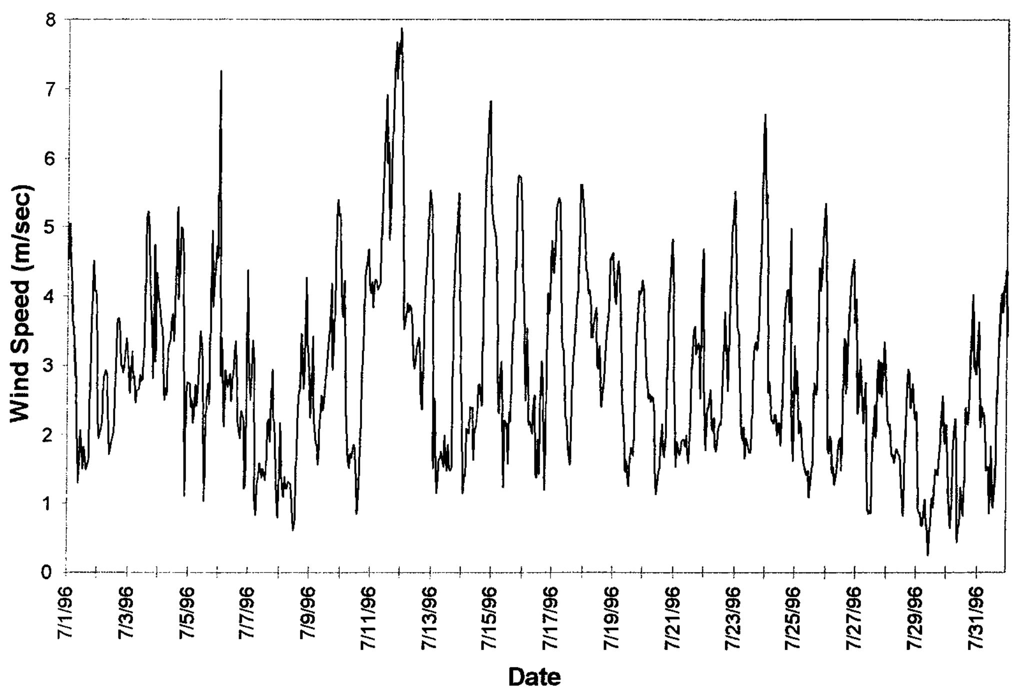

Figure 59. Wind speed at the Battelle site for July 1996

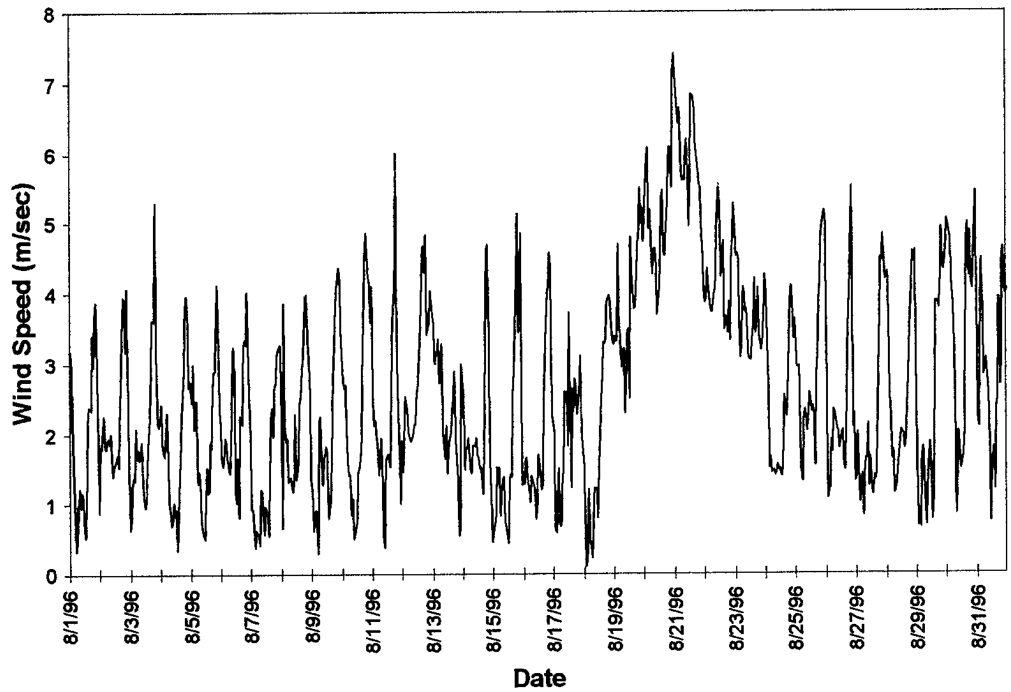

Figure 60. Wind speed at the Battelle site for August 1996

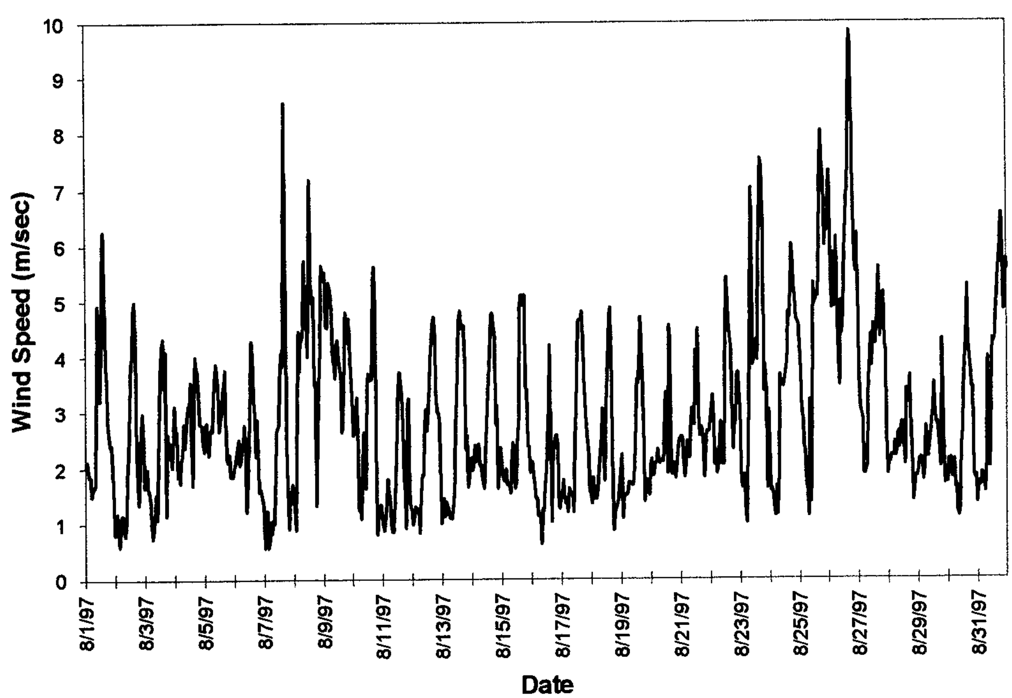

Figure 61. Wind speed at the Battelle site for August 1997

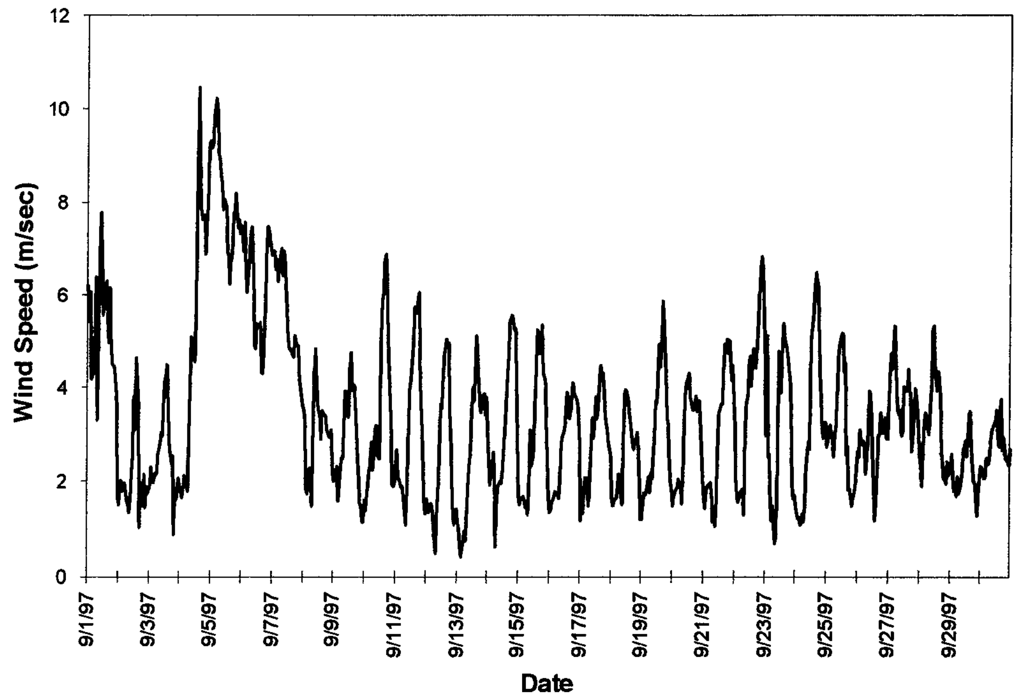

Figure 62. Wind speed at the Battelle site for September 1997

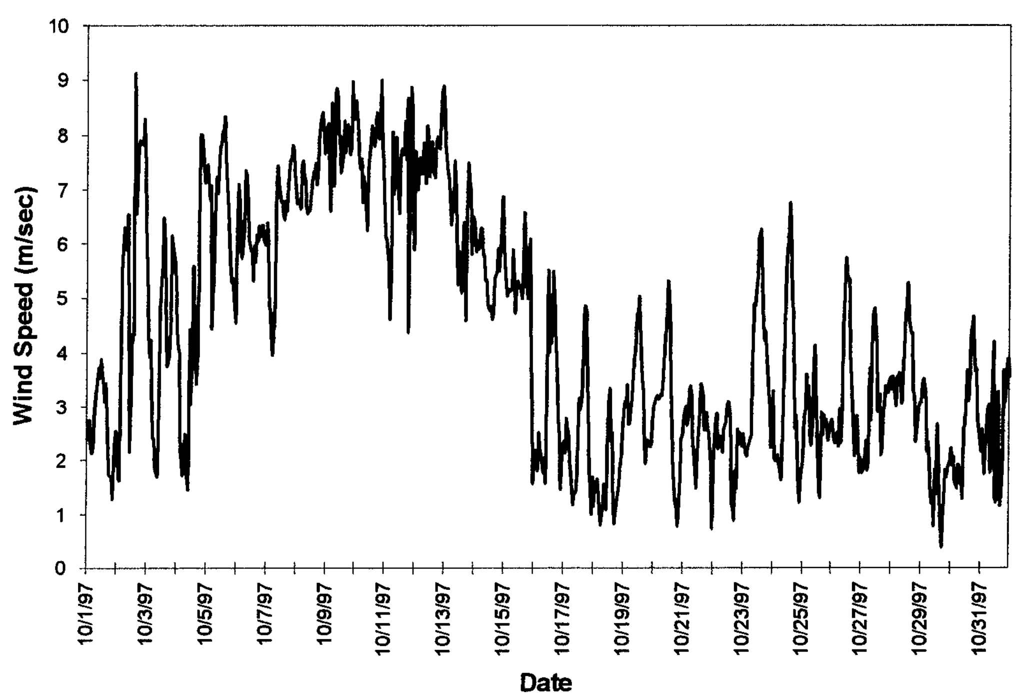

Figure 63. Wind speed at the Battelle site for October 1997

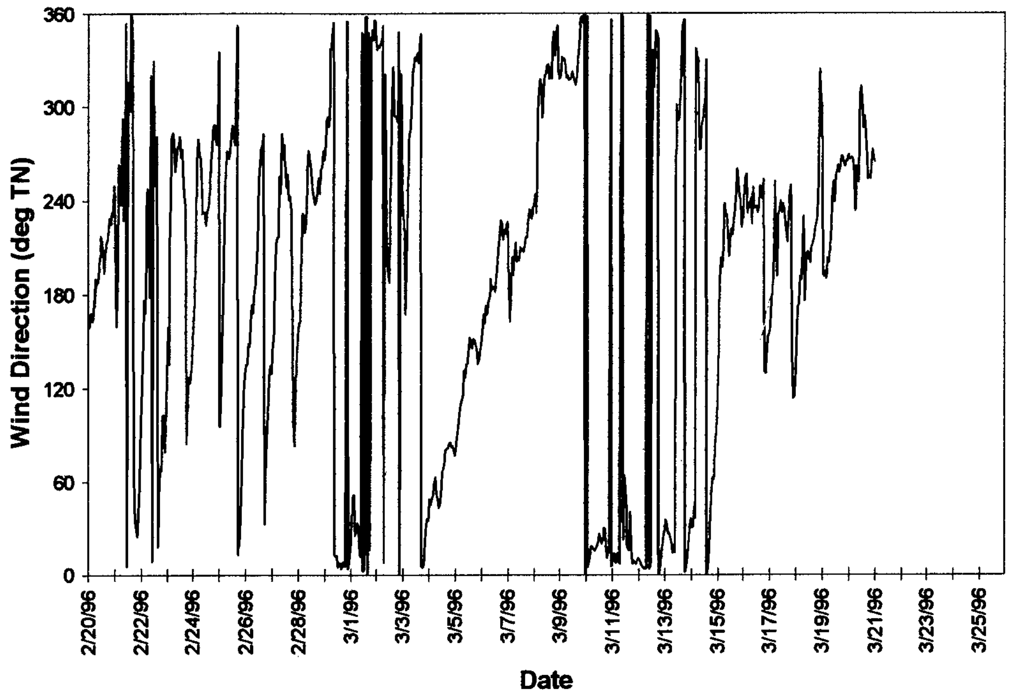

Figure 64. Wind direction at the Battelle site for 20 February - 20 March 1996

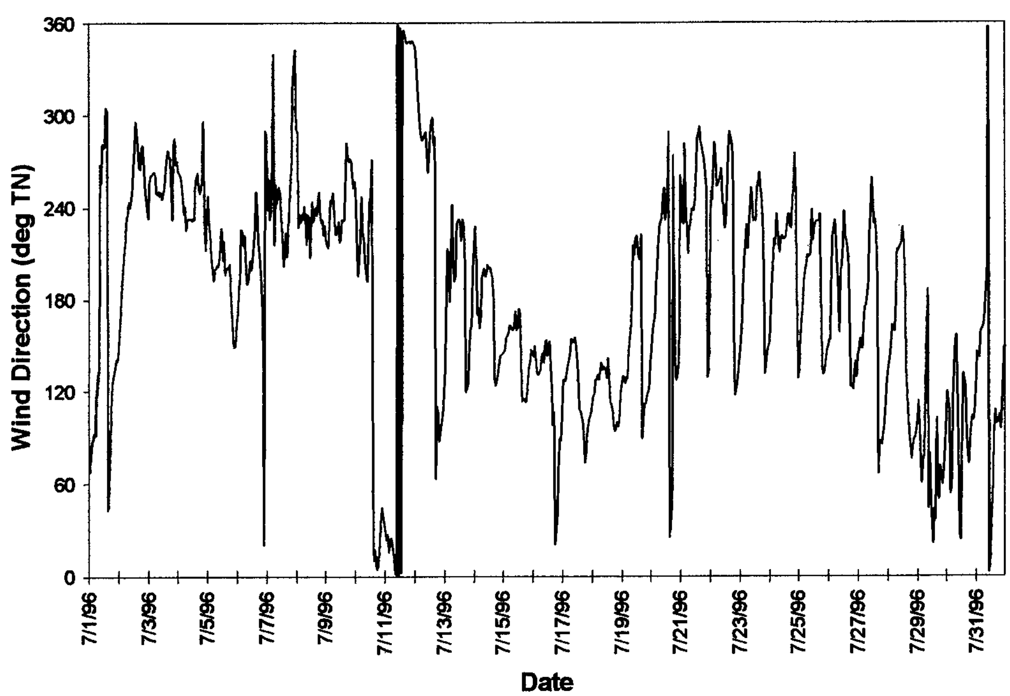

Figure 65. Wind direction at the Battelle site for July 1996

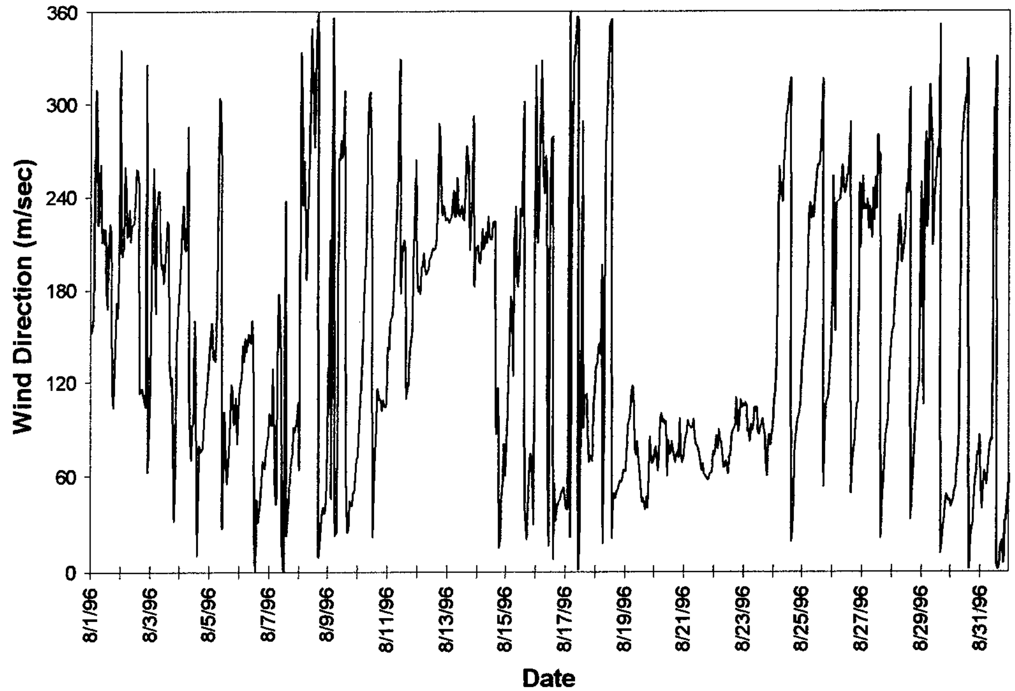

Figure 66. Wind direction at the Battelle site for August 1996

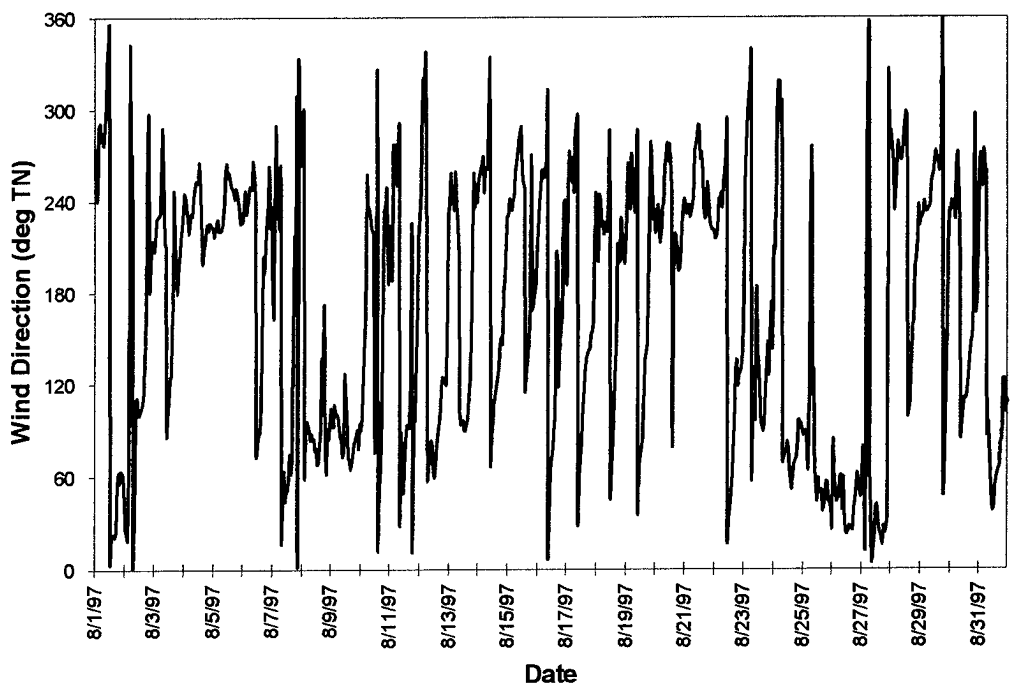

Figure 67. Wind direction at the Battelle site for August 1997

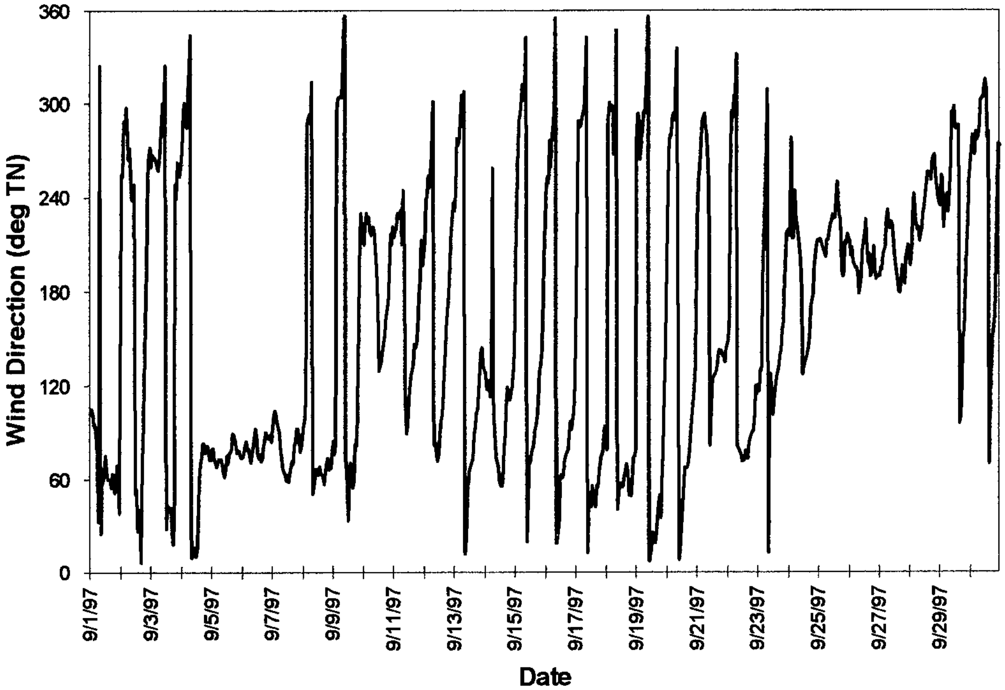

Figure 68. Wind direction at the Battelle site for September 1997

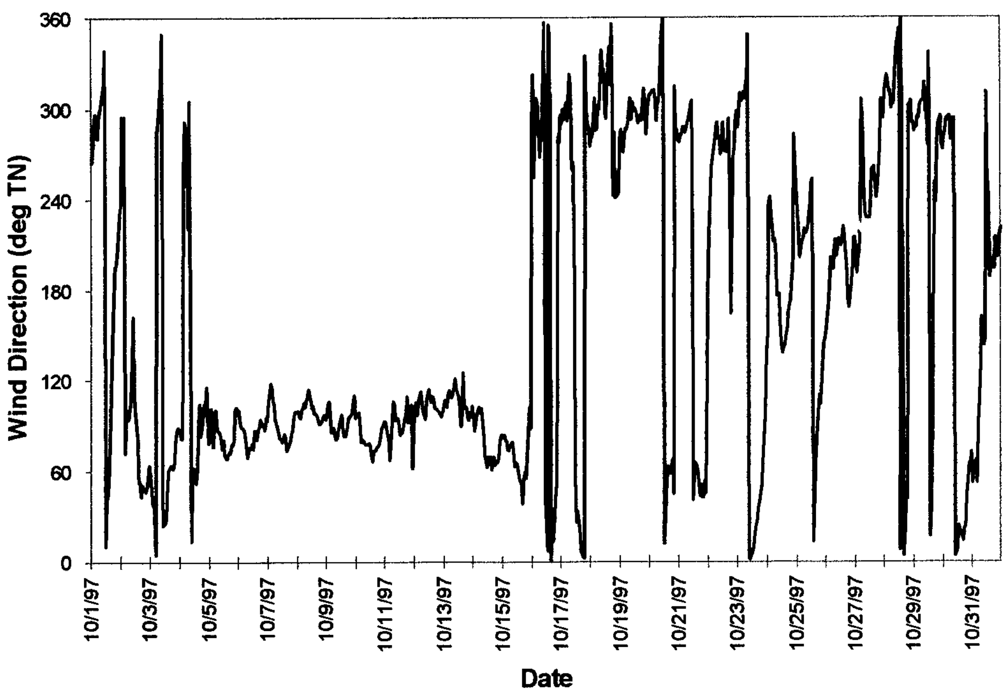

Figure 69. Wind direction at the Battelle site for October 1997

Sediment Results

All samples were sieved at quarter-phi (¼ φ) intervals. Sediment statistics were calculated using the method of moments (Friedman and Sanders 1978). Mean (the average grain size) and standard deviation (a measure of uniformity or sorting of the sediment) values were calculated for each sediment sample. Ponce de Leon Inlet had a narrow range of mean grain sizes, most centered in the fine sand range, with little shell and no gravel size components. Most of these samples were well sorted and the mean and median were similar. Only the few coarser sand samples generally had poorer sorting. Samples from the flood and ebb shoals were relatively finer than the throat and flood channels, and most of the beach samples. For the flood and ebb shoals, the average mean grain size was around 0.15 mm (2.70 φ), for the throat and flood channels and beaches, around 0.18 mm (2.45 φ). A few low tide samples and the south flood channel (SFC3) sample contained shells and shell fragments and were substantially coarser (up to 0.42 mm, 1.26 φ). Figure 70 shows the sample locations. Table 7 lists data on sample location and sediment statistics. Further details on sediment analysis can be found in Stauble and Cialone (1997).

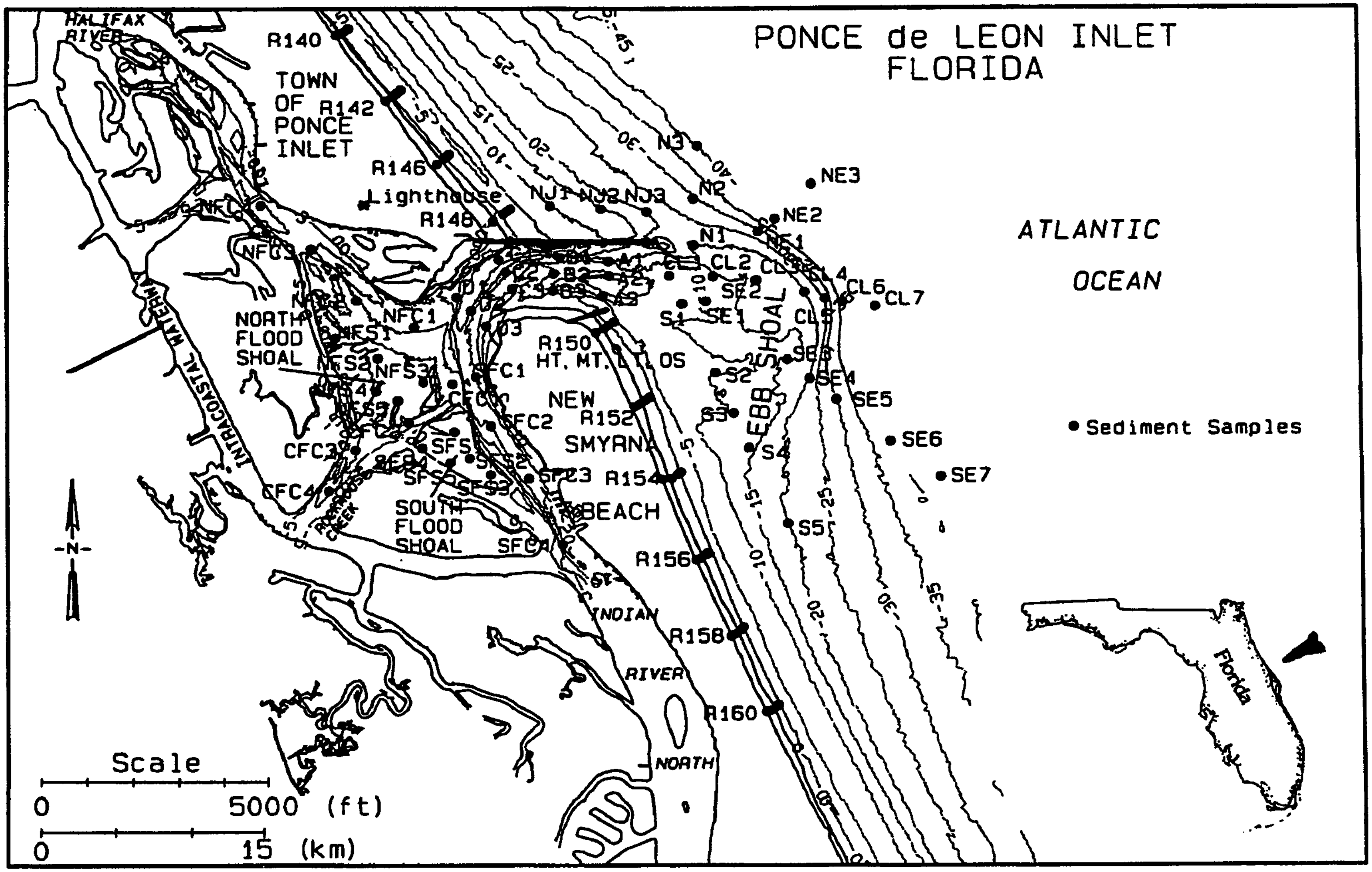

Figure 70. Location of sediment samples at Ponce de Leon Inlet, Florida. Bathymetry from SHOALS survey 1995

Table 7
Ponce de Leon Inlet Sediment Samples

Location	Easting	Northing	Mean (phi)	Mean (mm)	Sorting (phi)
Ebb Shoal					
NJ1	527042.92171	1725410.26827	2.61	0.16	0.80
NJ2	528174.22928	1725342.62027	2.73	0.15	0.46
NJ3	529169.78717	1725275.51215	2.80	0.14	0.46
N1	530190.94692	1724496.97415	2.29	0.21	0.85
N2	530189.00397	1725581.74875	2.74	0.15	0.54
N3	530285.97042	1726804.78147	2.88	0.14	0.48
NE1	531605.18276	1724813.88100	2.87	0.14	0.43
NE2	531978.12110	1725109.93713	2.87	0.14	0.44
NE3	532803.62704	1725923.92624	2.71	0.15	0.82
CL1	529663.40009	1723791.15365	2.28	0.21	0.67
CL2	530612.11792	1723762.82500	2.56	0.17	0.54
CL3	531571.00588	1723675.13722	2.73	0.15	0.48
CL4	532638.14409	1723394.86231	2.78	0.15	0.52
CL5	533099.85337	1723248.60489	2.88	0.14	0.50
CL6	533498.15264	1723165.32649	2.90	0.13	0.43
CL7	534227.09117	1723058.11879	2.90	0.13	0.54
SE1	530454.47988	1723179.10314	2.63	0.16	0.71
SE2	531539.60599	1723661.77738	2.73	0.15	0.66
SE3	532240.21925	1721804.92466	2.87	0.14	0.62
SE4	532746.93921	1721351.45172	2.95	0.13	0.43
SE5	533342.07903	1720863.52941	3.05	0.12	0.29
SE6	534554.76856	1719880.45499	3.06	0.12	0.45
SE7	535659.29790	1719048.81837	2.65	0.16	1.21
S1	529934.38129	1723117.47348	2.74	0.15	0.48
S2	530650.17396	1721496.33730	2.78	0.15	0.87
S3	531046.55557	1720537.94141	2.76	0.15	0.86
S4	531376.79693	1719726.76338	2.91	0.13	0.37
S5	532237.67949	1717948.21990	3.09	0.12	0.31

(Sheet 1 of 4)

Table 7 (Continued)					
Location	Easting	Northing	Mean (phi)	Mean (mm)	Sorting (phi)
		Throat/Channel			
CH A1	528338.06232	1724116.76772	2.58	0.17	0.41
CH A2	528350.55322	1723784.07243	2.51	0.18	0.50
CH A3	528202.37489	1723310.05896	2.59	0.17	0.56
CH B1	527261.52459	1724210.51533	2.15	0.22	0.80
CH B2	527124.44597	1723835.89046	2.20	0.22	0.61
CH B3	527113.55713	1723435.30608	2.23	0.21	1.22
CH C1	525886.44797	1724162.26465	2.28	0.21	0.95
CH C2	526047.41841	1723874.51884	2.28	0.21	0.49
CH C3	526196.22919	1723478.89453	2.05	0.24	0.64
CH D1	524937.28278	1723274.41609	2.06	0.24	0.98
CH D2	525265.44290	1722963.14078	2.41	0.19	0.67
CH D3	525602.16314	1722599.75621	2.33	0.20	0.67
		Flood Channels			
NFC 1	523987.95711	1722571.41488	2.45	0.18	0.59
NFC 2	522734.84825	1723202.10481	2.46	0.18	0.63
NFC 3	521746.56697	1724407.49717	2.28	0.21	1.06
NFC 4	520625.89647	1725432.86200	2.30	0.20	0.87
CFC 1	524838.00893	1721241.15434	2.46	0.18,	0.66
CFC 2	523861.08403	1720322.39601	2.09	0.24	0.84
CFC 3	522699.71883	1719682.33350	2.28	0.21	0.59
CFC 4	522118.86317	1718723.86604	2.23	0.21	0.90
SFC 1	525359.65716	1721411.79255	2.45	0.18	0.80
SFC 2	525690.02971	1720243.60927	2.26	0.21	0.80
SFC 3	526553.96105	1719017.63751	1.47	0.36	1.28
SFC 4	527297.33359	1717454.64045	2.60	0.17	0.53
		Flood Shoals			
NFS 1	522271.26202	1722311.47664	2.50	0.18	0.61
NFS 2	523189.28120	1721840.66416	2.68	0.16	0.40
NFS 3	524186.14041	1721283.38301	2.57	0.17	0.43
					(Sheet 2 of 4)

Table 7 (Continued)					
Location	**Easting**	**Northing**	**Mean (phi)**	**Mean (mm)**	**Sorting (phi)**
Flood Shoals (Continued)					
NFS 4	523150.90361	1721060.69493	2.68	0.16	0.43
NFS 5	523628.28307	1720843.37849	2.75	0.15	0.43
SFS 1	524872.01216	1720102.87026	2.68	0.16	0.38
SFS 2	525216.28309	1719485.39930	2.90	0.13	0.34
SFS 3	525688.52299	1719107.27518	2.83	0.14	0.41
SFS 4	524152.28506	1719724.39468	2.71	0.15	0.33
SFS 5	524783.28449	1719379.40025	2.80	0.14	0.35
North Beach (Town of Ponce Inlet)					
R142HT	522310.55070	1729400.22884	2.83	0.14	0.31
R142MT	522407.95042	1729422.09860	2.64	0.16	0.37
R142LT	522487.81007	1729482.27783	2.25	0.21	0.56
R142OS	522566.67971	1729543.81704	1.62	0.32	1.11
R144HT	523395.81290	1727859.17096	2.83	0.14	0.40
R144MT	523540.46227	1727960.69967	2.44	0.18	0.57
R144LT	523620.36192	1728020.87890	2.48	0.18	0.53
R144OS	523707.60148	1728104.32782	2.39	0.19	0.60
R146HT	524510.39471	1726389.07230	2.79	0.14	0.52
R146MT	524672.66393	1726527.35052	2.43	0.19	0.52
R146LT	524744.54361	1726581.50983	1.82	0.28	0.78
R146OS	524784.47343	1726611.59945	2.48	0.18	0.71
R148HT	525769.23565	1725062.12196	2.67	0.16	0.37
R148MT	525998.26465	1725225.31989	2.48	0.18	0.60
R148LT	526078.12430	1725285.49912	2.42	0.19	0.65
R148OS	526157.98394	1725345.67835	2.39	0.19	0.79
South Beach (New Smyrna Beach)					
R150HT	528056.08767	1722441.52106	2.77	0.15	0.49
R150MT	528233.31699	1722530.13000	2.51	0.18	0.58
R150LT	528333.14654	1722605.35905	2.52	0.17	0.60
R150OS	528452.94600	1722695.62790	2.30	0.20	0.83
					(Sheet 3 of 4)

Table 7 (Concluded)					
Location	Easting	Northing	Mean (phi)	Mean (mm)	Sorting (phi)
South Beach (New Smyrna Beach) (Continued)					
R152HT	528901.28044	1720702.28658	2.84	0.14	0.38
R152MT	528999.21006	1720754.47595	2.66	0.16	0.44
R152LT	529119.00951	1720844.74481	2.58	0.17	0.52
R152OS	529218.83906	1720919.97386	1.26	0.42	1.28
R154HT	529495.74367	1718993.77151	2.48	0.14	0.38
R154MT	529689.54314	1719007.86155	2.50	0.18	0.56
R154LT	529829.30249	1719113.18023	2.34	0.20	0.86
R154OS	529889.20222	1719158.30966	2.39	0.19	0.65
R156HT	530222.46697	1717105.38929	2.74	0.15	0.32
R156MT	530314.01664	1717140.00892	2.66	0.16	0.34
R156LT	530433.79608	1717230.27779	2.42	0.19	0.69
R156OS	530473.74589	1717260.36742	2.74	0.15	0.41
R158HT	530952.36993	1715305.50596	2.74	0.15	0.27
R158MT	531035.93958	1715350.42544	2.73	0.15	0.32
R158LT	531155.73902	1715440.69432	2.60	0.16	0.50
R158OS	531228.55862	1715517.91332	2.08	0.24	0.93
R160HT	531724.39258	1713543.85229	2.65	0.16	0.35
R160MT	531829.27221	1713574.24202	2.55	0.17	0.38
R160LT	531949.07165	1713664.51090	2.65	0.16	0.38
R160OS	531989.00146	1713694.60053	2.41	0.19	0.60
R176MT	538820.00000	1699920.00000	2.73	0.15	0.31
Bethune Beach					
R200MT	550808.00000	1680450.00000	1.71	0.31	1.18
BBSHMT	552750.00000	1676200.00000	1.23	0.43	1.13
Canaveral National Seashore					
CNS5MT	566900.00000	1652830.00000	0.39	0.76	0.60
					(Sheet 4 of 4)
NOTE: Translated Coordinates on NAD 27 Florida East State Plane Zone,U.S. FOOT					

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Appendix A Velocity and Discharge Measurements at Ponce de Leon Inlet, Florida

This appendix contains a revised copy of a memorandum for record dated 26 January 1998, regarding velocity and discharge measurements at Ponce de Leon Inlet, FL.

Introduction

Short-term field measurements were conducted at Ponce De Leon Inlet, FL, to support the Inlet Modeling System work unit for development and validation of the circulation and wave model. The subject field investigation, which consisted of two 1-week Acoustic Doppler Current Profiler (ADCP) surveys during the periods 25-29 August 1997 and 15-19 September 1997, was conducted by the staff of the Coastal and Hydraulics Laboratory (CHL) at the U.S. Army Engineer Waterways Experiment Station. Results from these activities are discussed herein. Additional information was obtained from several sources. A 2-month deployment of six in situ pressure and two-component velocity gauges (PUV's) was conducted by Florida Institute of Technology. The SHOALS team performed a high-resolution bathymetric survey. Aerial photographs were taken by Aerial Cartographics of America, Inc. of Orlando, FL. Dr. Donald Stauble obtained sediment samples from the interior and exterior of the inlet. Finally, meteorological data were obtained from the Battelle Paint Test Facility adjacent to the inlet.

The ADCP and bathymetric data surveys were conducted by Messrs. Howard Benson, Thad Pratt, and Terry Waller, CHL. Other participants in the surveys from CHL included Ms. Adele Militello and Dr. Jane Smith. The boat and boat operator were supplied by DIMCO, Inc.

Bathymetric Survey and Tide Data

The bathymetric data collected during this effort were not comprehensive and, therefore, do not represent a full bathymetric survey. The bathymetric data were mainly collected along each of the ADCP transect lines. The areas in which these transect lines were located include the north and south bays, the Intracoastal Waterway (ICWW), the inlet, and on the ebb shoal. Additional bathymetric data were collected between each of the inlet transect lines, many of the north and south bay transect lines, along depth contours in the inlet and ebb shoal, and along the center lines of the bay and inlet channels. These data were collected to aid in the interpretation of the ADCP results, as well as provide information for updating the 1996 SHOALS survey in designated critical areas. The constant presence of swells, particularly in the area of the ebb shoal, made for poor surveying conditions. As a result, the depth soundings recorded the up and down movement of the boat and gave the appearance of sand waves forming on the shoal. The bathymetric data were collected concurrent with the ADCP data collection using a 200-kHz Echotrac fathometer.

These data were corrected to National Geodetic Vertical Datum using information from CHL's Prototype Measurement and Analysis Branch (PMAB) water-level gauges. Time-history plots of the tide data from one of the PMAB water-level gauges during the two ADCP and bathymetric survey periods (August and September) are shown in Plates A1 and A2. The PMAB water-level gauge located near the Coast Guard Station in the south bay area was used due to its relative proximity to the inlet. Data are plotted in Eastern Standard Time (EST) for correlation with the ADCP data. The maximum neap tide range during the week of 25 August was 1.05 m. The maximum spring tide range during the week of 15 September was 1.35 m.

ADCP Surveys

ADCP surveys were performed to measure the current distributions (variations across the channel and through the vertical) and discharges in the inlet system. These roving measurements provide a means for obtaining comprehensive information on the spatial variability throughout the inlet system, unlike the more limited in situ gauges (tide and PUV), which provide data on the temporal variability at only a few locations. The two 1-week ADCP surveys were conducted during 25-29 August and 15-19 September. These dates coincided with periods of neap and spring tide conditions, respectively.

An RD Instruments Broadband ADCP was used to obtain the velocity magnitude and direction profiles for each transect. This instrument uses a 1,200-kHz operating frequency. The equipment is mounted over the side of the boat with the acoustic transducers submerged and data are collected while the vessel is under way.

The ADCP transmits sound bursts into the water column which are scattered back to the instrument by particulate matter suspended in the flowing water. The ADCP listens for the returning signal and assigns velocity to the received signal based on the change in the frequency caused by the moving particles. This change in frequency is referred to as a Doppler shift. The ADCP is also capable of measuring vessel direction, current direction, and bottom depth. Communications with the instrument for setup and data recording are performed with a portable computer using manufacturer-supplied software, hardware, and communication cables. The manufacturer-stated accuracy for current speed measurement is ± 0.2 cm/sec.

The data collection boat was outfitted with a Global Positioning System (GPS) receiver antenna. U.S. Coast Guard GPS transmitter beacons, positioned at various locations along the Florida coast, provided differential GPS positioning for a higher level of accuracy during the data collection. The outputs from these instruments were interfaced to a laptop computer using a hydrographic surveying software system known as HYPACK. This combination permitted accurate logging of location from a known GPS starting coordinate at each velocity profile transect. The data collection boat traversed the transect line at a slow constant speed (approximately 4-7 km/hr) to obtain the best possible spatial coverage.

The data collection transect lines throughout the study area were located to provide the best information to support the modeling effort. However, certain field conditions were encountered, such as shallow flats, marshes, and shoal migration near the inlet, that necessitated transect line locations be moved, shortened, or lengthened in order to obtain the full discharge and flow patterns within the cross sections.

Neap Tide Data Collection

Plate A3 illustrates the location of the areas monitored for the data collection effort during trip one. During this first survey, a priority was placed on the collection of bathymetric information, as well as the ADCP data. Therefore, the first day's effort covered numerous transect lines in the bay areas. Table A1 summarizes the ADCP data collected on 25 August 1997. It contains line numbers, times (EST), and discharges for the areas in the south bay, north bay, and ICWW. Direction of the total discharge flow listed in this table is presented as flood or ebb flow and indicated by + and -, respectively. Except for the summary table of the intensive surveys, the tables and Plates summarizing the data collection are presented in chronological order and not in order of line number. Chronological order presentation of the data was selected because the transects were not monitored by sequential line number order. Plates A4-A7 present the depth-averaged velocity vector plots for data collected on 25 August. The integration of the GPS coordinates for each vertical profile along the transect line accurately defines the location of the velocity vector data shown in the Plates. Transect lines with velocity vectors that do not plot from bank to bank indicate that either bank movement or shallow water areas were encountered during the data collection. For the purposes of data presentation, the arrow shows flow direction and the velocity magnitude is indicated by the adjacent number. All the Plates showing velocity vectors are plotted at the same scale. The Plates for each day are in order of time.

The intensive ADCP survey of the inlet area was conducted on 26 August. The discharge data are summarized in Table A2, but are not plotted. Table A3 presents a summarizes of the 27 August data collection effort, which was concentrated in the north bay and the ICWW areas during ebb flow conditions. Depth-averaged velocity vector data for the transects in these areas are shown in Plates A8-A12. Bathymetric and ADCP data were collected on the ebb shoal on 28 August. The ADCP discharges for this area are summarized in Table A4 and the depth-averaged velocity vectors are plotted in Plates A13-A16. Data collected in the south bay area on 29 August are summarized in Table A5 and plotted in Plates A17-A20.

The following is a detailed daily summary of the data collection effort conducted in the respective areas during this first trip (neap tide).

Inlet surveys

On 26 August an intensive data collection effort was conducted. ADCP transect lines 1-9 (shown in Plate A21) in the inlet were repeated at approximately 1-hr increments over a 12-hr period. (Note: Inlet transect lines 1-9 differ from transect lines 1-9 in the bay area.) The transect lines began at the north jetty and ran to the south. Each set of transects required approximately 30-45 min to complete. Waves in the outer portions of the inlet were generally 1 m high with short periods; however, conditions deteriorated during periods of ebb flow. Data collection efforts at the most seaward transect line (7), which ran between the seaward ends of the jetties, were hampered by the high wave conditions and only a few hours of data were obtained at this location. The waves in the inner inlet area were significantly smaller and more conducive to longer periods of data collection. Data collected at transect lines 8 and 9 occurred near the time of the peak flood currents and captured the division of flow between the north and south portions of the bay, respectively. Hourly results of the intensive survey are summarized in Table A2.

Ebb shoal surveys

ADCP transect lines 69 and 77-84 (in the ebb shoal area) were monitored on 28 August. Morning measurements at these transects were made under ebb flow conditions and the afternoon measurements were made under flood flow conditions. These transect lines were up to 3.0 km long, requiring approximately 4 hr to conduct each set of transects. During the morning survey, transect line 80 had to be shortened due to breaking waves on the shoal. The offshore waves were 1.2 m in height with periods of 7-8 sec, and winds were light. Large breakers were focused on the ebb shoal just seaward of the south jetty. Table A4 presents the discharges for each set of measurements and the data are plotted in Plates A13-A16. The data generally illustrate the wave direction; however, near the end of the jetties, the velocity vectors indicate the tidal current direction.

North bay surveys

On 25 August, a partial flood flow condition survey, which included transect lines 26-31, was made in an area of the north bay located between the inlet and extending 1.6 km to the north (Plates A5 and A6). To complement the data set, a longitudinal transect along the channel center line was also obtained. On 27 August, selected ADCP transect lines in north bay (beginning at the inlet and extending approximately 8 km to the north) were monitored during ebb flow conditions (Plates A8-A10).

South bay surveys

On 25 August, ADCP transect lines 1-10 in the south bay were monitored during flood flow conditions (Plates A4 and A5). On 29 August, the south bay transect lines 4, 5, 7, 9, and 10 (beginning 5 km south of the inlet and extending to the inlet) were monitored during ebb flow conditions (Plates A17 and A18).

ICWW surveys

On 25 August, ADCP transects in the ICWW were monitored during flood flow conditions and slack conditions (Plates A5-A7). The transect lines are located in the area between the confluences of the ICWW with the north and south bay channels and the feeding channels behind the inlet. On 27 August, ICWW transect lines 13, 17, and 19 were repeated during flood flow conditions (Plates A11 and A12). During this period, longitudinal transects along the main channel and side channel center lines were also monitored.

Spring Tide Data Collection

During the week of 15-19 September, the data collection effort was conducted for a spring tide condition. The majority of the ADCP transect lines, monitored during the neap tide period, were repeated for this data collection effort. For the spring tide measurements, a greater priority was placed on obtaining data during periods of peak ebb and flood currents. Additionally, the transect lines at the inlet (96), the entrance to the north bay (30), and the entrance to the south bay (4) were repeated frequently in an effort to determine current direction and magnitude both before and after each data set was collected. Plate A22 identifies the locations for each area monitored during this spring tide data collection period. On 15 September, ebb and flood flow conditions were monitored in the south bay area. These data are summarized in Table A6, and the depth-averaged velocity vectors are presented in Plates A23-A28. During the morning of 16 September, transect lines on the ebb shoal were monitored for ebb flow conditions. These data are summarized in Table A7, and the depth-averaged velocity vector plots are presented in Plate A29. During the afternoon of 16 September, currents for ebb flow conditions were monitored in the north bay area. These data are also summarized in Table A7, and the depth-averaged velocity vector plots are presented in Plates A30-A33. Measurements on 17 September began on the ebb shoal during flood flow conditions. Afternoon measurements, on this same day, were made on the ICWW during ebb flow conditions. The data are summarized in Table A8 and plotted in Plates A34-A38. On 18 September, an intensive 13-hr data collection effort was conducted in the inlet area. These data are summarized in Table A9 but are not plotted. The data collection efforts for 19 September were designed to cover transect lines located in areas of the north bay and the ICWW during flood flow conditions. The data obtained for this period are summarized in Table A10, and velocity vector plots are presented in Plates A39-A42.

The following is a detailed daily summary of the data collection effort conducted in the respective areas during the period of the second trip (spring tide).

Inlet survey

On 18 September, the inlet survey was conducted at a peak spring tide. Table A9 summarizes the discharges. The total number of transect lines monitored in the inlet area were identical to those from the neap tide survey. However, due to extreme wave and current interactions, the outside (seaward) lines were determined to be too dangerous to run. Transect lines 8 and 9, which determined the splitting of the flow to the north and south bay areas, were monitored at or near periods of peak ebb and flood flow conditions.

Ebb shoal surveys

The ebb shoal depth-averaged velocity vector data are plotted in Plates A29 and A34. The number of lines monitored during this period was reduced to five from the original eight. The five transect lines that were monitored include: 77, 80, 81, 82, and 83. Line 77 extends eastward from the jetty. The remaining four lines are oriented from north to south and are nearly perpendicular to the axis of the main channel. Each data set for these five lines required approximately 2.5 hr to complete. During the ebb flow condition, the waves (swell) were about 1 m high and from an east-northeast direction. At the beginning of the flood tidal survey, the waves (swell) were about 0.5 m high from the east. The depth-averaged velocity vector Plates depict the maximum currents near the jetties. Further away from the end of the jetties, the influence of the waves appears to override the tidal current velocities.

North and south bay surveys

North and south bay channel surveys were performed on flood and ebb tide. The total number of transect lines surveyed in these areas was reduced from those from the neap tide survey period. This reduction in transect lines was done to provide adequate time to complete the north bay channel section. The omitted lines were near and similar to adjacent lines so that no vital information was lost. The north and south bay channel surveys were usually started by monitoring transect lines 96, 4, and 30, in that order, to determine the flow distribution between the inlet, the south channel, and the north channel, respectively. During the flood flow conditions in the north bay area, the transect lines at the extreme north end of the bay were not surveyed in order that measurements of velocities in the ICWW areas could be obtained. The ebb flow data in the south bay are shown in Plates A23 and A24, while the flood flow data are shown in Plates A27 and A28. The north bay ebb flow data are shown in Plates A30-A33 and the flood data are shown in Plates A39-A41.

ICWW survey

The reach of the ICWW located between the confluences with the north and south bay channels was surveyed for ebb and flood tidal conditions on 17 and 19 September, respectively. The velocity vector plots for the data obtained on these dates are shown in

Plates A35-A37 and Plates A39-A41, respectively. The ICWW survey also included transect lines (11 and 32) in the creeks located between the ICWW and the inlet.

General Observations

During the neap and spring ADCP and bathymetry surveys, the following observations were made:

a. During the neap tide intensive ADCP survey the maximum discharges measured through the inlet were about 1,700 cu m/sec on flood and 1,300 cu m/sec on ebb. The spring tide intensive survey measured maximum discharges of 2,200 cu m/sec on flood and 1,600 cu m/sec on ebb. In the bay area, approximately half of the flow goes to the south at near maximum flood flows. The remainder of the flow is split between the north bay and the creeks flowing into the ICWW. These creeks are located on ADCP transect lines 11 and 32.

b. There was significant wave action throughout the neap tide measurement period. Waves were breaking over the north jetty almost the whole week, and at high tide, waves were propagating over the jetty causing very rough conditions in the throat of the inlet. The ebb shoal was found to be extremely shallow just seaward and south of the south jetty. As a result, it was very common to have 2.0- to 2.5-m waves breaking in this region.

c. During both the neap and spring surveys of the ebb shoal area, ebb currents were observed to be deflected to the south near the tips of the jetties. This was probably due to the waves from the northeast. Also evident in the data were reversals in the current directions north and south of the inlet. The somewhat erratic current direction offshore is also influenced by the waves present during the data collection.

d. Very strong currents were found to exist throughout the entire study area. Current speeds of 60 cm/sec north and south of the inlet in the bays were commonly observed. Peak currents observed in the inlet were approximately 100 cm/sec.

e. There is a large difference in tidal phase between the water level and current during spring tide. Strong currents in the ebb direction were observed while the water level continued to rise in the bay. The water level had risen substantially from the low tide elevation and the currents were still observed to be in an ebb direction. A similar phenomenon was observed for the falling tide; the water level would decrease and the current continued in the flood direction.

f. The flows in the ICWW were generally observed to be from south to north when the flood currents in the inlet were strong . The flows were from north to south when the ebb currents in the inlet were strongest.

Table A1
Ponce de Leon Inlet Discharge Rates on 25 August 1997

Date	Line No.	Time EST	Discharge m^3/sec
South Bay - see Plates A4 and A5			
8/25/97	10	1107	+266.6
	10	1119	+349.9
	99	1157	+492.1
	9	1206	+520.1
	8	1218	+469.6
	7	1229	+665.9
	6	1242	+679.2
	5	1256	+724.2
	4	1313	+776.6
	2	1326	+703.6
	1	1337	+915.1
North Bay - see Plates A5 and A6			
8/25/97	31	1354	+105.0
	30	1403	+553.7
	29	1411	+588.9
	28	1421	+619.0
	27	1433	+522.4
	26	1439	+382.2
	132	1452	+66.6
	232	1500	+60.9
	232	1503	+67.8
Intracoastal Waterway - see Plates A5, A6, and A7			
8/25/97	20	1511	+124.4
	33	1516	+247.1
	34	1523	+114.4
	19	1530	+217.1
	18	1537	+214.5
	17	1542	+147.9
	16	1549	+124.7

(Continued)

Table A1 (Concluded)

Date	Line No.	Time EST	Discharge m^3/sec
Intracoastal Waterway (continued)			
8/25/97	15	1554	± 6.5
	11	1615	± 14.2
	14	1625	± 24.4
	13	1632	± 55.1

Table A2
Ponce de Leon Inlet Discharge Rates on 26 August 1997

Date	Line No.	Time EST	Discharge m^3/sec
Inlet Throats - see Plate A21			
8/26/97	1	706	-1217.1
		752	-1198.5
		839	-978.7
		1006	-557.0
		1055	+209.4
		1226	+1260.3
		1327	+1612.0
		1447	+1711.8
		1556	+1161.7
		1704	+411.3
		1758	-661.2
	2	654	-1233.4
		744	-1160.2
		830	-1117.6
		956	-563.7
		1046	+59.9
		1218	+1204.5
		1319	+1606.4
		1439	+1514.0
		1548	+1376.9
		1656	+586.2
		1750	-406.5
		1843	-1201.5
	3	648	-1052.3
		738	-982.7
		824	-863.4
		951	-519.1
		1041	-8.4
		1213	+860.8

(Sheet 1 of 3)

Table A2 (Continued)			
Date	Line No.	Time EST	Discharge m^3/sec
		Inlet Throats (Continued)	
8/26/97	3	1313	+1080.9
		1434	+985.4
		1543	+818.9
		1651	+400.6
		1744	-234.9
	4	643	-861.7
		733	-902.5
		820	-891.7
		947	-486.5
		1037	-94.9
		1206	+668.0
		1308	+884.0
		1430	+805.9
		1538	+688.5
		1648	+339.5
		1740	-199.6
		1835	-671.1
	5	639	-810.2
		730	-982.1
		816	-910.0
		943	-552.6
		1033	-264.3
		1201	+491.4
		1303	+789.3
		1426	+704.5
		1534	+532.1
		1645	+388.1
		1736	-161.8
	6	631	-1148.1
			(Sheet 2 of 3)

Table A2 (Concluded)			
Date	**Line No.**	**Time EST**	**Discharge m^3/sec**
		Inlet Throat (Continued)	
8/26/97	6	723	-1235.2
		808	-1104.2
		936	-688.9
		1025	-301.9
		1154	+935.2
		1255	+1393.3
		1419	+1409.6
		1527	+1258.8
		1638	+684.1
		1730	±6.1
		1827	-1086.8
	7	1147	+779.0
		1242	+1222.1
		1412	+1189.9
		1521	+1286.4
	8	1357	+617.8
	9	1346	+680.5
			(Sheet 3 of 3)

Table A3
Ponce de Leon Inlet Discharge Rates on 27 August 1997

Date	Line No.	Time EST	Discharge m^3/sec
North Bay - see Plates A8, A9, and A10			
8/27/97	24	730	-247.5
	23	737	-318.5
	22	743	-345.7
	21	751	-406.1
	20	757	-124.4
	35	804	-486.7
	36	813	-407.0
	37	821	-478.6
	38	830	-436.8
	39	840	-338.8
	40	847	-339.3
	41	859	-220.8
	35	1000	-468.5
Intracoastal Waterway - see Plates A11 and A12			
8/27/97	13	1412	+19.9
	17	1441	+222.3
	19	1504	+271.6

Table A4
Ponce de Leon Inlet Discharge Rates on 28 August 1997

Date	Line No.	Time EST	Discharge m^3/sec
Ebb Shoal - Ebb Tide- see Plates A13 and A14			
8/28/97	77	716	1661.3
	84	742	2784.6
	83	813	2961.0
	82	851	1315.8
	81	931	1293.3
	80	1013	378.9
	79	1035	196.1
	78	1051	100.7
	69	1104	929.1
Ebb Shoal - Flood Tide - see Plates A15 and A16			
8/28/97	77	1313	2626.4
	84	1344	2678.2
	83	1413	4047.4
	82	1450	3520.7
	76	1540	592.7
	81	1558	2597.2
	80	1633	2093.5
	79	1730	522.5
	78	1740	290.5

Table A5
Ponce de Leon Inlet Discharge Rates on 29 August 1997

Date	Line No.	Time EST	Discharge m^3/sec
South Bay - see Plates A17 and A18			
8/29/97	10	942	-388.8
	9	957	-413.7
	7	1011	-265.0
	5	1018	-533.7
	4	1037	-616.8
	96	1050	-1141.0
North Bay - see Plates A18, A19, and A20			
8/29/97	29	1106	-268.4
	29	1301	-126.8
	35	1326	-277.0

Table A6
Ponce de Leon Inlet Discharge Rates on 15 September 1997

Date	Line No.	Time EST	Discharge m³/sec
	South Bay - see Plates A23 and A24		
9/15/97	96	953	-1537.6
	30	1023	-581.0
	4	1040	-831.3
	5	1054	-679.6
	6	1106	-349.7
	7	1115	-382.5
	8	1125	-345.5
	9	1138	-529.5
	10	1153	-515.0
	10	1209	-502.1
	96	1425	-299.9
	North Bay/South Bay Inlet Area - see Plates A25 and A26		
9/15/97	30	1442	±88.5
	96	1456	+263.3
	4	1517	+253.3
	30	1531	+284.6
	96	1542	+1264.5
	4	1557	+614.4
	South Bay - see Plates A27 and A28		
9/15/97	30	1608	+539.7
	96	1616	+1713.2
	4	1631	+773.6
	5	1641	+741.8
	6	1649	+361.9
	7	1658	+401.2
	8	1704	+602.1
	9	1714	+624.3
	10	1725	+619.5

Table A7
Ponce de Leon Inlet Discharge Rates on 16 September 1997

Date	Line No.	Time EST	Discharge m^3/sec
Ebb Shoal - Ebb Tide - see Plate A29			
9/16/97	77	946	1557.4
	81	1017	1934.0
	80	1041	909.0
	82	1057	2058.6
	83	1121	1905.7
	177	1148	1254.4
North Bay - see Plates A30, A31, A32, and A33			
9/16/97	96	1256	-1464.0
	4	1313	-768.8
	30	1324	-492.7
	29	1334	-404.0
	28	1344	-478.6
	27	1354	-453.7
	132	1359	**
	26	1406	-82.7
	126	1417	-290.2
	23	1429	-330.0
	21	1439	-346.4
	20	1452	-137.7
	35	1500	-470.9
	36	1511	-394.2
	37	1521	-416.8
	38	1533	-363.9
	39	1546	-313.9
	40	1554	-343.3
	41	1605	-239.1

** Data not available

Table A8
Ponce de Leon Inlet Discharge Rates on 17 September 1997

Date	Line No.	Time EST	Discharge m^3/sec
Ebb Shoal - Flood Tide - see Plate A34			
9/17/97	80	735	1339.5
	81	752	643.0
	82	814	271.8
	83	842	1501.4
	77	905	2416.7
Intracoastal Waterway - see Plates A35, A36, A37, and A38			
9/17/97	30	1117	-518.5
	96	1124	-1512.1
	4	1139	-754.8
	5	1150	-618.3
	13	1200	-116.0
	14	1209	-98.9
	15	1216	-54.3
	11	1222	-227.5
	16	1234	-285.4
	17	1244	-269.4
	18	1253	-236.7
	232	1305	-59.5
	19	1313	-301.3
	34	1325	-143.1
	20	1335	-151.1
	35	1343	-592.5
	21	1351	-455.5
	96	1425	-1262.9

Table A9
Ponce de Leon Inlet Discharge Rates on 18 September 1997

Date	Line No.	Time EST	Discharge m^3/sec
Inlet Throats - see Plate A21			
9/18/97	1	624	+1561.4
		722	+2053.0
		833	+2211.7
		917	+1844.9
		1009	+1175.1
		1105	-544.1
		1205	-1364.8
		1310	-1540.9
		1404	-1458.3
		1507	-1350.6
		1604	-815.5
		1656	-513.5
		1812	+723.9
	2	630	+1466.8
		737	+1893.1
		846	+1975.5
		932	+1522.2
		1020	+729.8
		1117	-858.0
		1215	-1599.9
		1323	-1627.4
		1415	-1573.0
		1521	-1186.2
		1614	-881.0
		1708	-406.3
	3	646	+1180.4
		747	+1576.9
		854	+1361.3
		940	+1087.2

(Sheet 1 of 3)

Table A9 (Continued)

Date	Line No.	Time EST	Discharge m^3/sec
Inlet Throats (Continued)			
9/18/97	**3**	**1029**	**+355.7**
		1128	-770.0
		1225	-1071.9
		1333	-1139.9
		1427	-1079.7
		1531	-967.8
		1623	-645.2
		1717	-231.9
		1828	+700.1
	4	653	+959.1
		753	+1178.0
		858	+982.9
		945	+692.9
		1034	+167.2
		1135	-560.7
		1231	-931.1
		1339	-962.1
		1433	-880.7
		1537	-860.8
		1630	-517.3
		1722	-123.1
		1832	+476.9
	5	657	+1548.9
		757	+1968.0
		902	+1909.7
		950	+1208.8
		1038	+169.7
		1138	-1257.3
		1234	-761.7
		1344	-522.2

(Sheet 2 of 3)

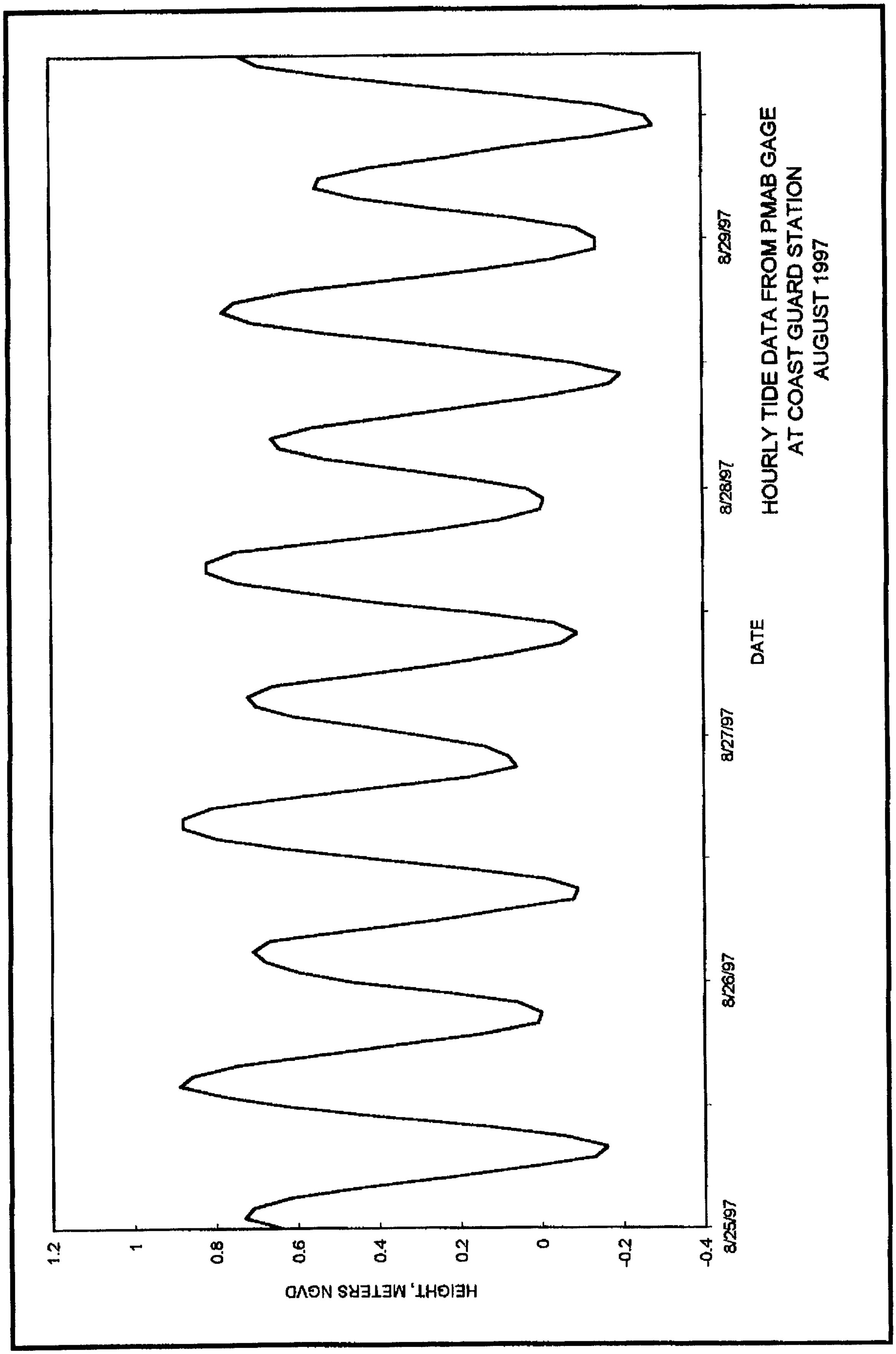
Table A9 (Concluded)			
Date	**Line No.**	**Time EST**	**Discharge m^3/sec**
		Inlet Throats (Continued)	
5 9/18/97	**5**	1541	-849.2
		1438	-555.0
		1633	-606.4
		1725	-111.2
		1836	+510.4
	6	705	+1523.8
		804	+1809.4
		908	+1557.7
		956	+849.7
		1046	+76.5
		1143	**
		1731	-87.4
	8	825	+554.8
		1304	-517.6
		1502	-438.1
	9	815	+950.7
		1247	-782.8
		1452	-710.4

** Data not available

(Sheet 3 of 3)

Table A10
Ponce de Leon Inlet Discharge Rates on 19 September 1997

Date	Line No.	Time EST	Discharge m^3/sec
North Bay - see Plates A39, A40, and A41			
9/19/97	96	757	+1874.5
	30	809	+562.8
	29	817	+563.5
	28	824	+732.4
	27	831	+752.6
	25	839	+192.5
	23	840	+443.0
	21	856	+577.0
	35	905	+788.5
Intracoastal Waterway - see Plates A39, A40, A41, and A42			
9/19/97	20	913	+159.1
	34	919	+196.1
	19	926	+346.8
	232	934	+111.0
	18	941	+260.3
	17	947	+301.0
	16	958	+302.8
	11	1004	+362.0
	14	1011	+54.1
	13	1017	+57.8
	4	1030	+690.3
	96	1040	+1461.4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AT COAST GUARD STATION
AUGUST 1997
HEIGHT, METERS NGVD
DATE
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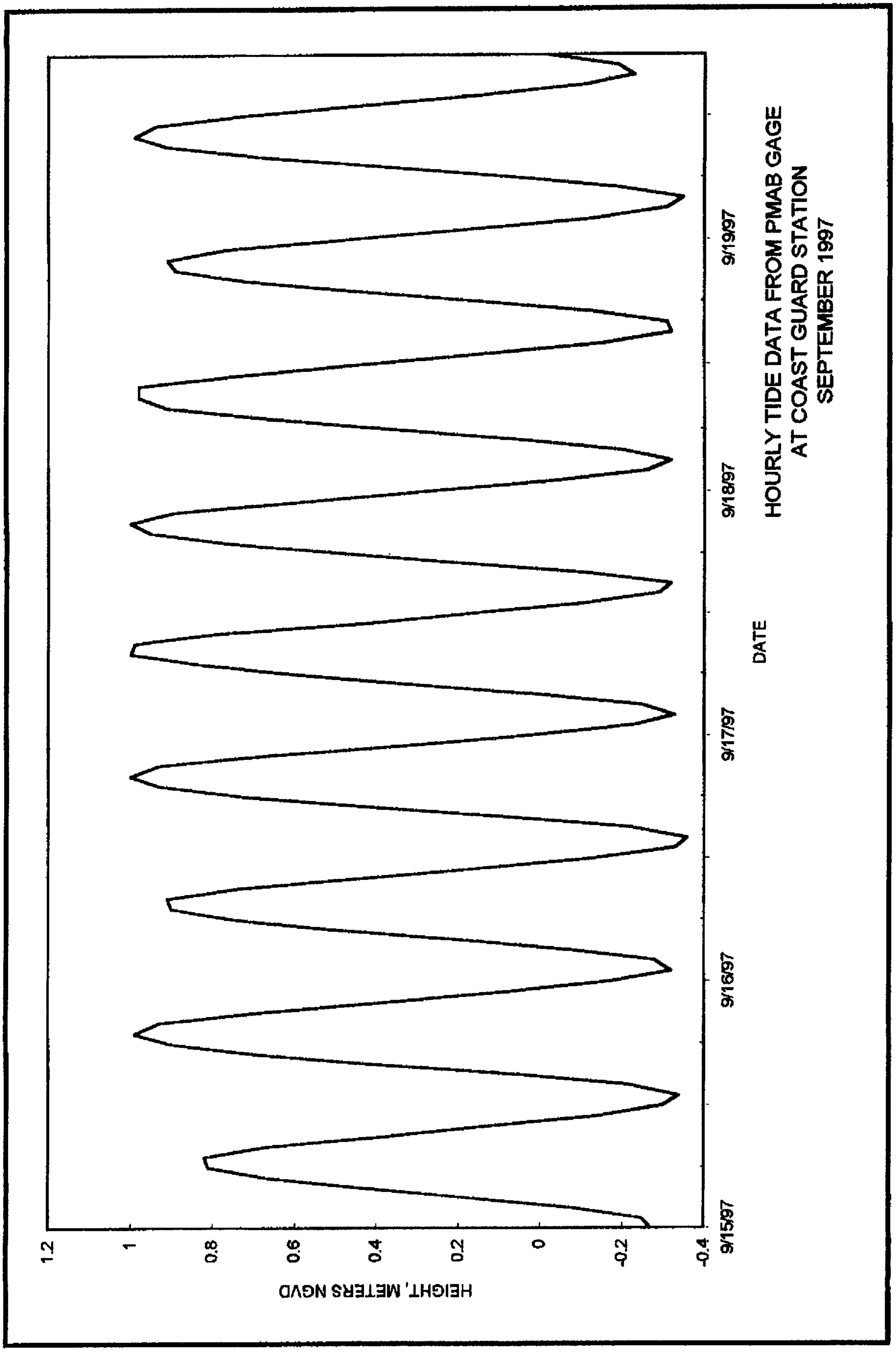
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
8/25/97
8/26/97
8/27/97
8/28/97
8/29/97

Plate A1


HOURLY TIDE DATA FROM PMAB GAGE
AT COAST GUARD STATION
SEPTEMBER 1997
HEIGHT, METERS NGVD
DATE
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1
0.8
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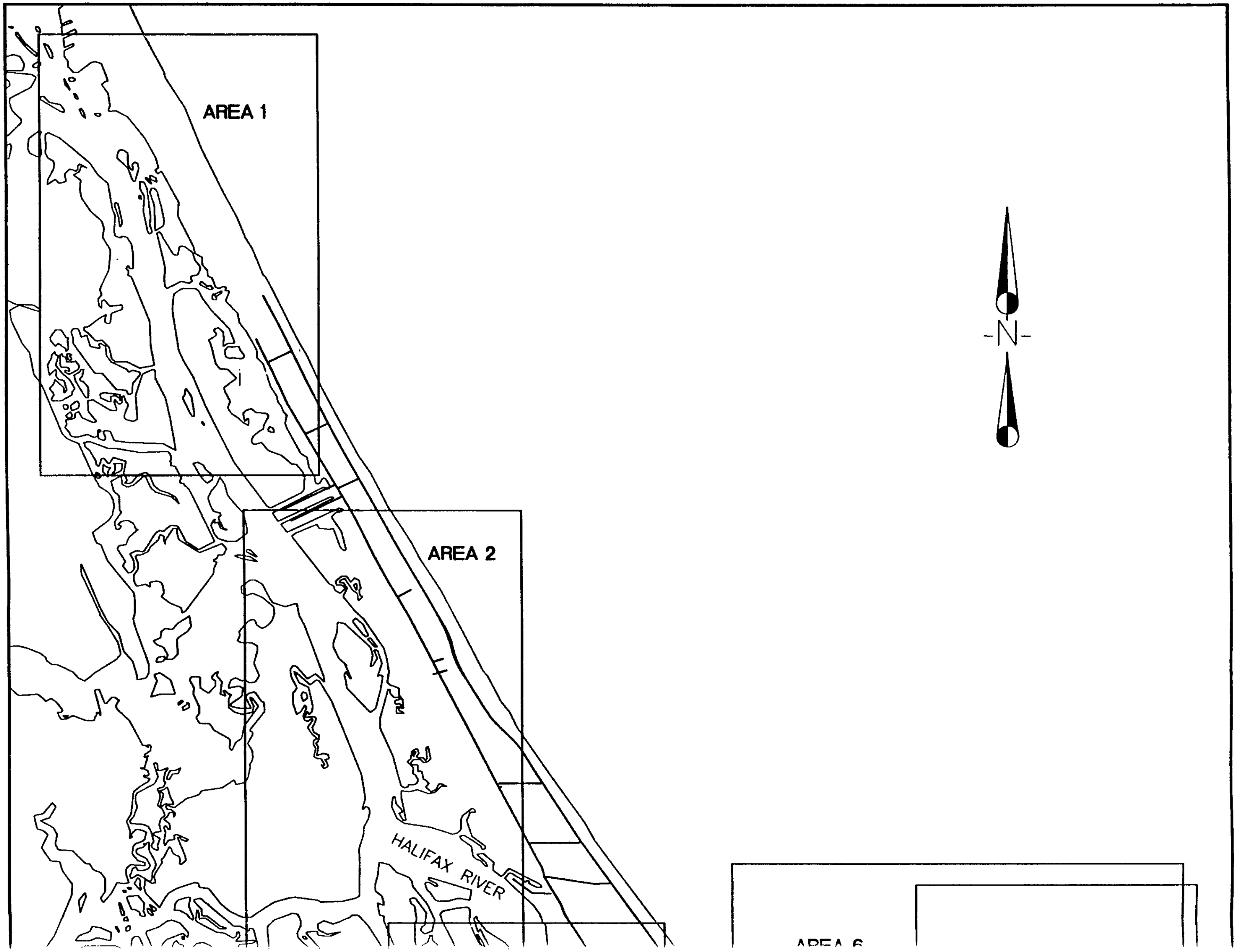
-0.4
9/15/97
9/16/97
9/17/97
9/18/97
9/19/97



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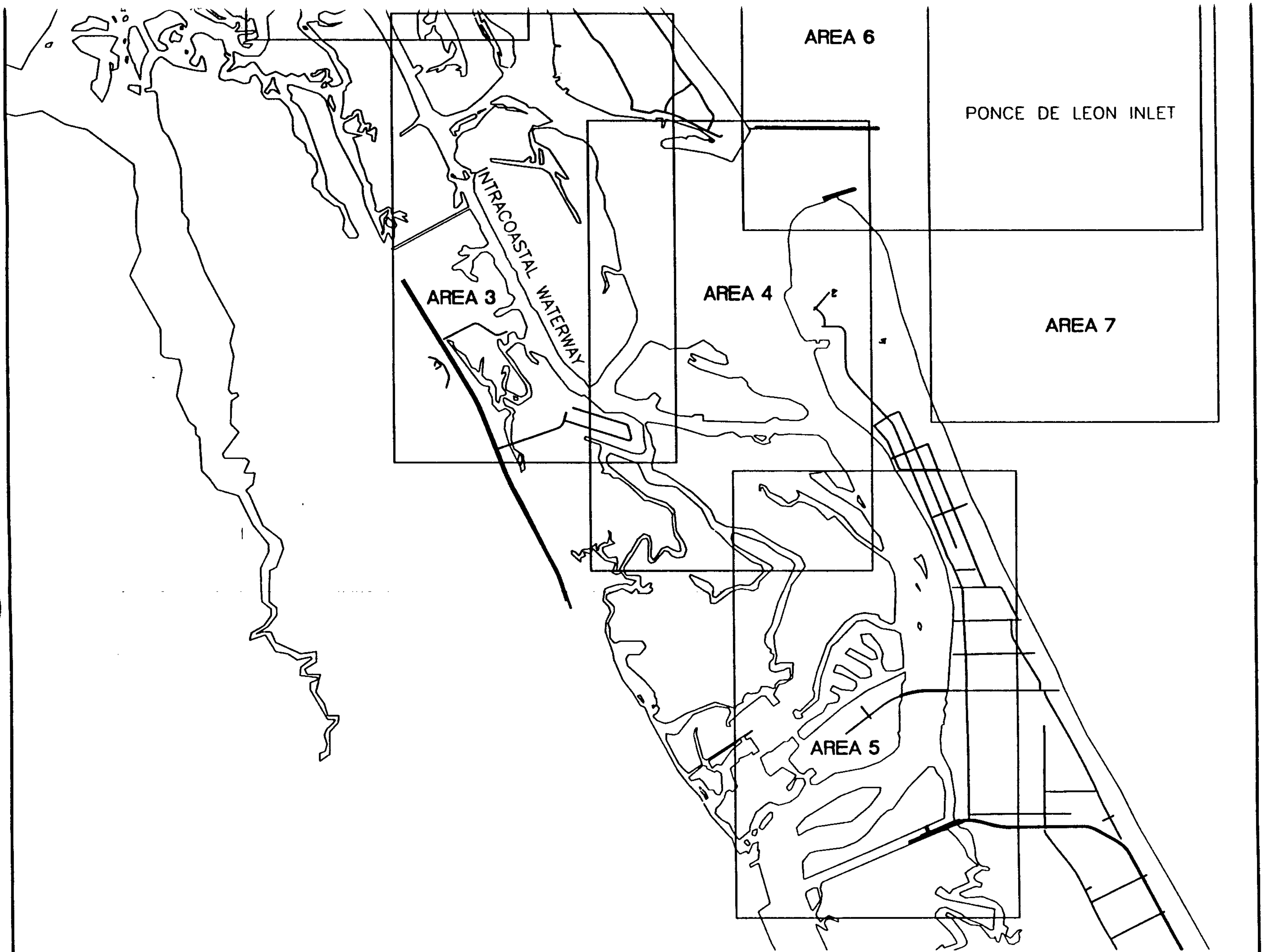
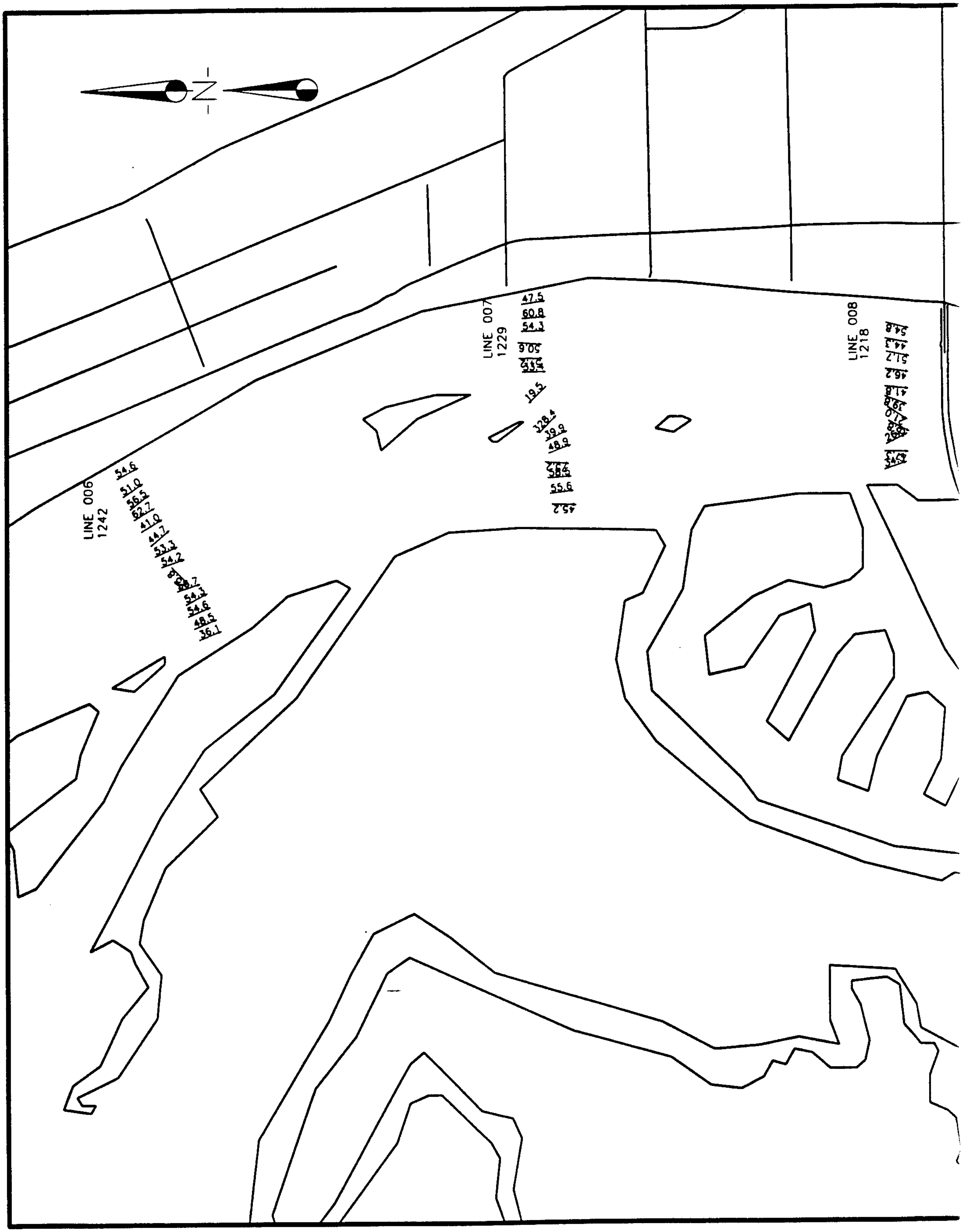


PONCE DE LEON INLET
PLATE LAYOUT
TRIP 1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54.3
54.6
48.5
36.1
LINE 007
1229
47.5
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54.3
19.5
39.9
48.9
55.6
LINE 008
1218

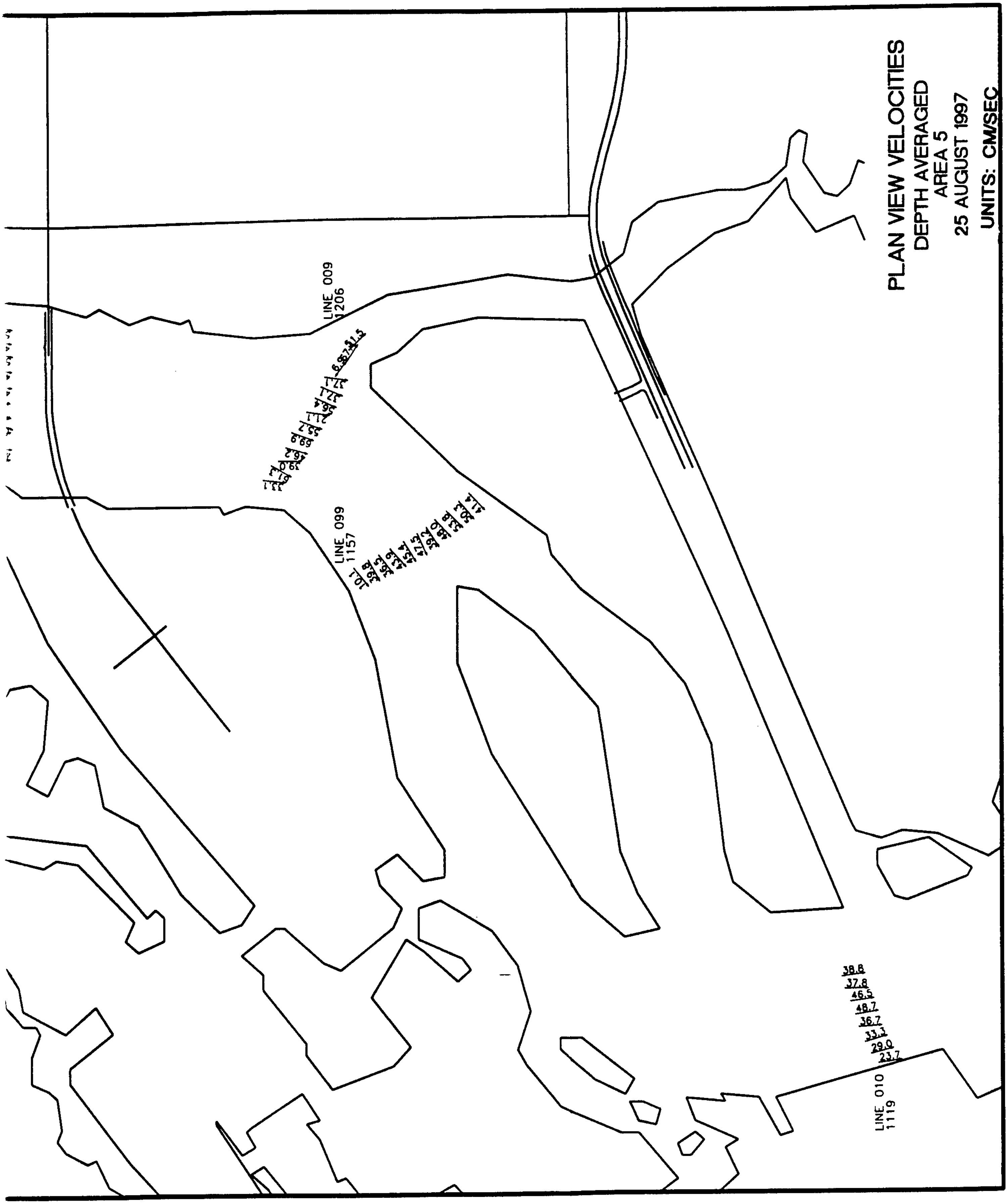
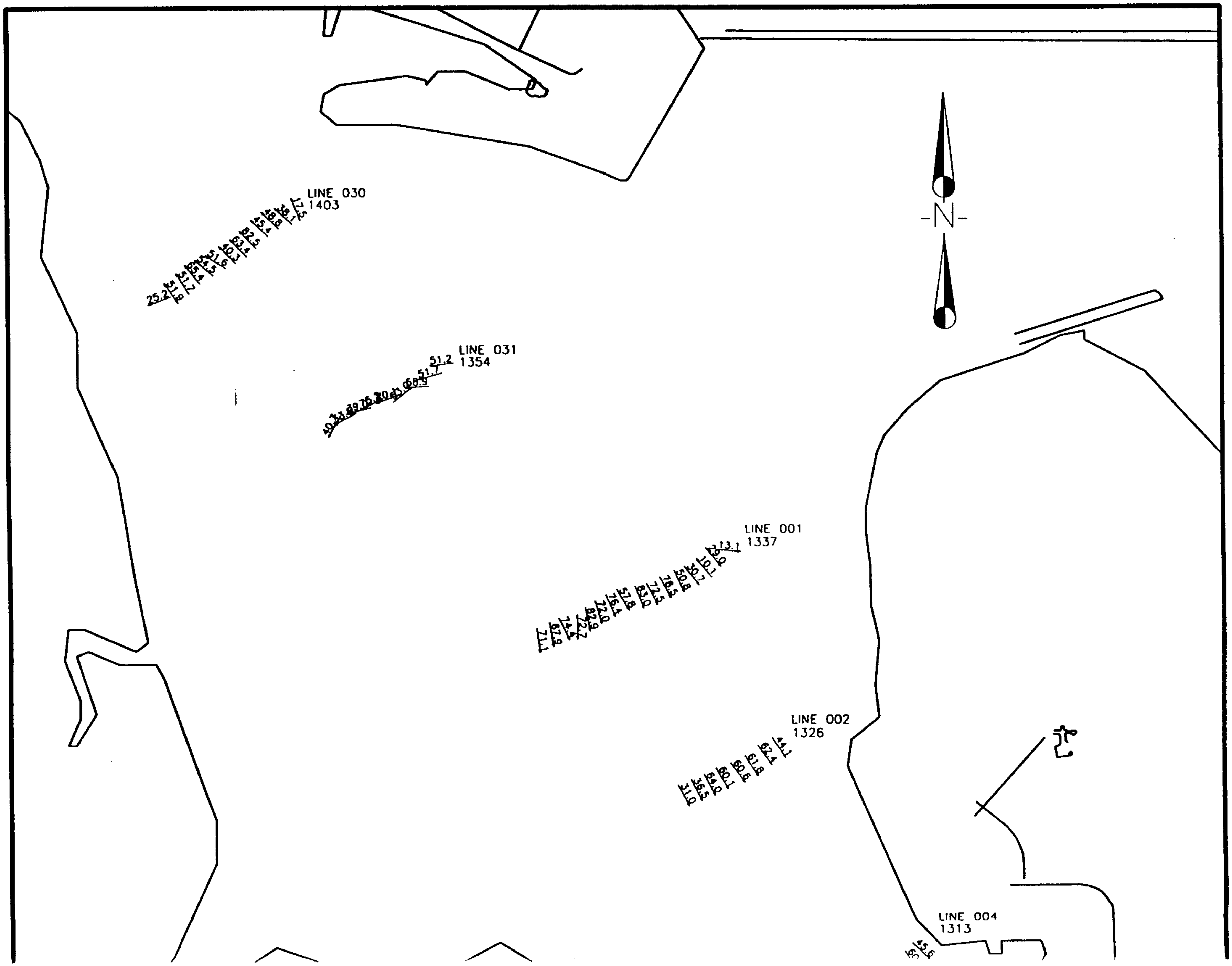

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 5
25 AUGUST 1997
UNITS: CM/SEC
LINE 009
1206
LINE 099
1157
LINE 010
1119
38.8
37.8
46.5
48.7
36.7
33.3
29.0
23.7

Plate A4



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1403
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38.1
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45.4
82.5
63.4
40.3
51.6
65.4
51.7
51.9
25.2
LINE 031
1354
51.2
51.7
68.9
LINE 001
1337
13.1
29.0
10.1
30.7
50.8
78.5
72.5
83.0
57.8
76.4
72.0
82.9
72.7
74.4
67.9
71.1
LINE 002
1326
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60.6
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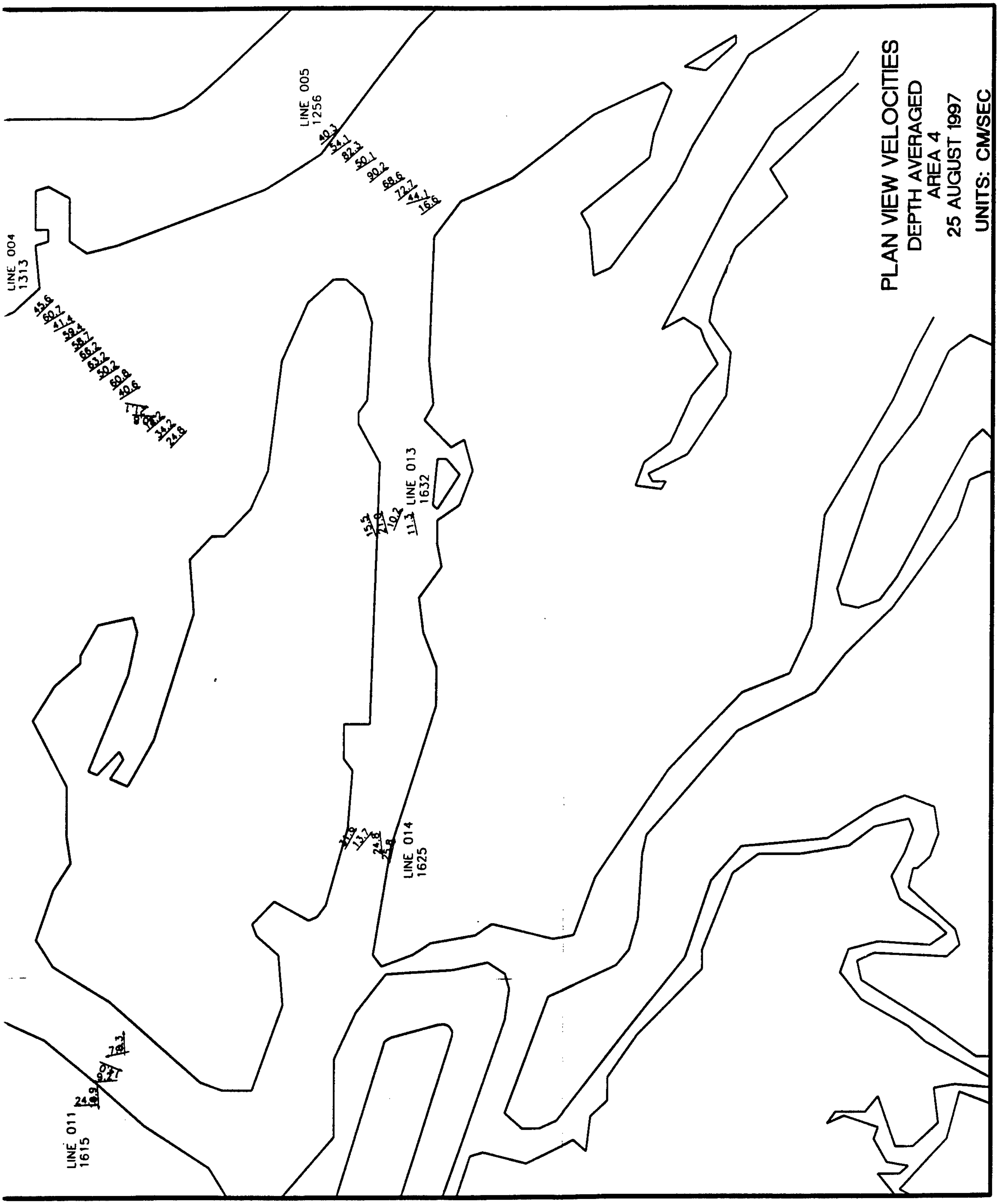
64.0
36.5
31.0
LINE 004
1313
45.6
N

1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
25 AUGUST 1997
UNITS: CM/SEC
LINE 005
1256
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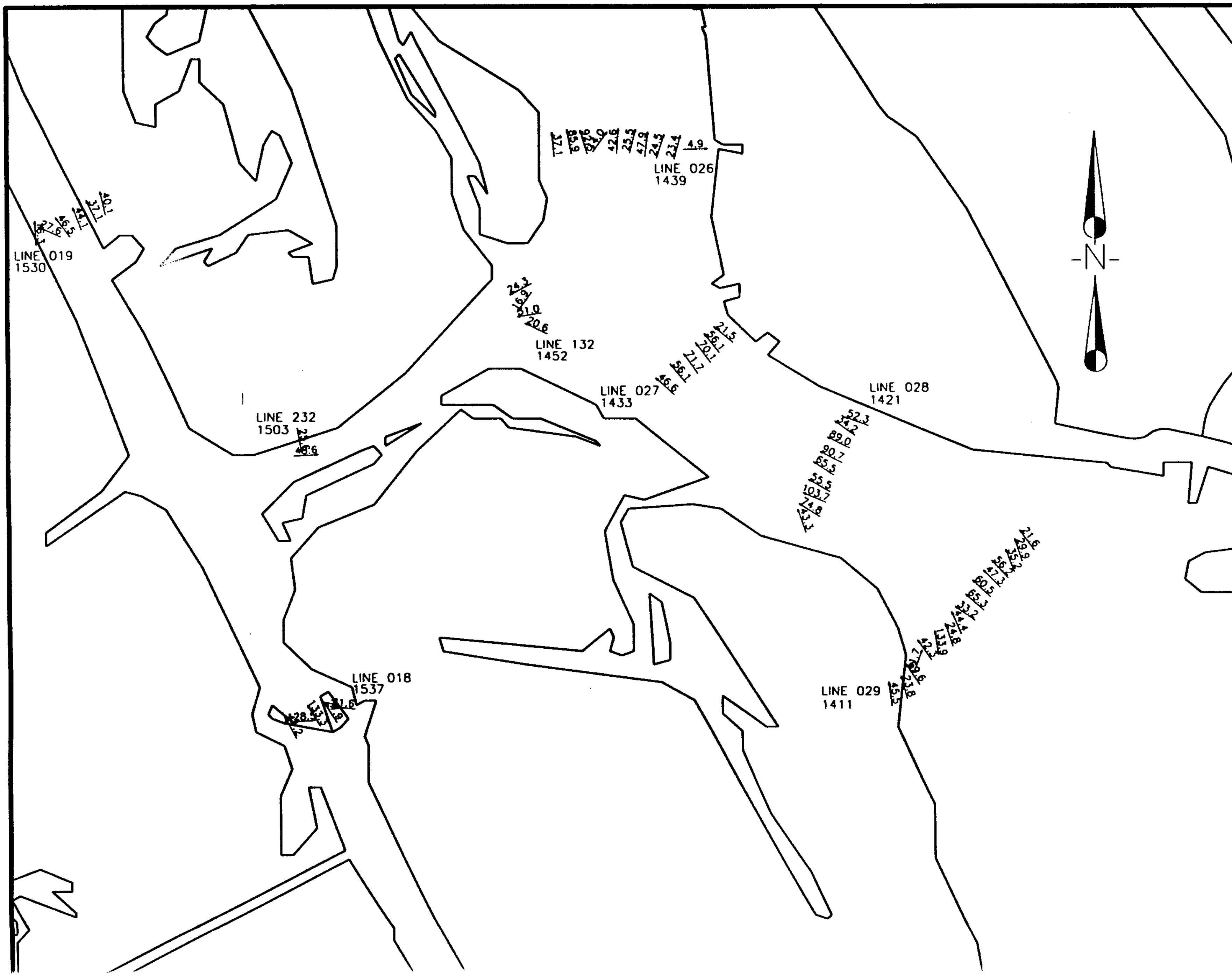
82.3
50.1
90.2
68.6
72.7
44.1
16.6
LINE 004
1313
45.6
60.7
41.4
59.4
58.7
66.2
63.2
50.2
60.8
40.6
14.2
24.8
LINE 013
1632
10.2
11.3
LINE 014
1625
13.7
LINE 011
1615
79.3

(2)

Plate A5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LINE 026
1439
LINE 028
1421
LINE 132
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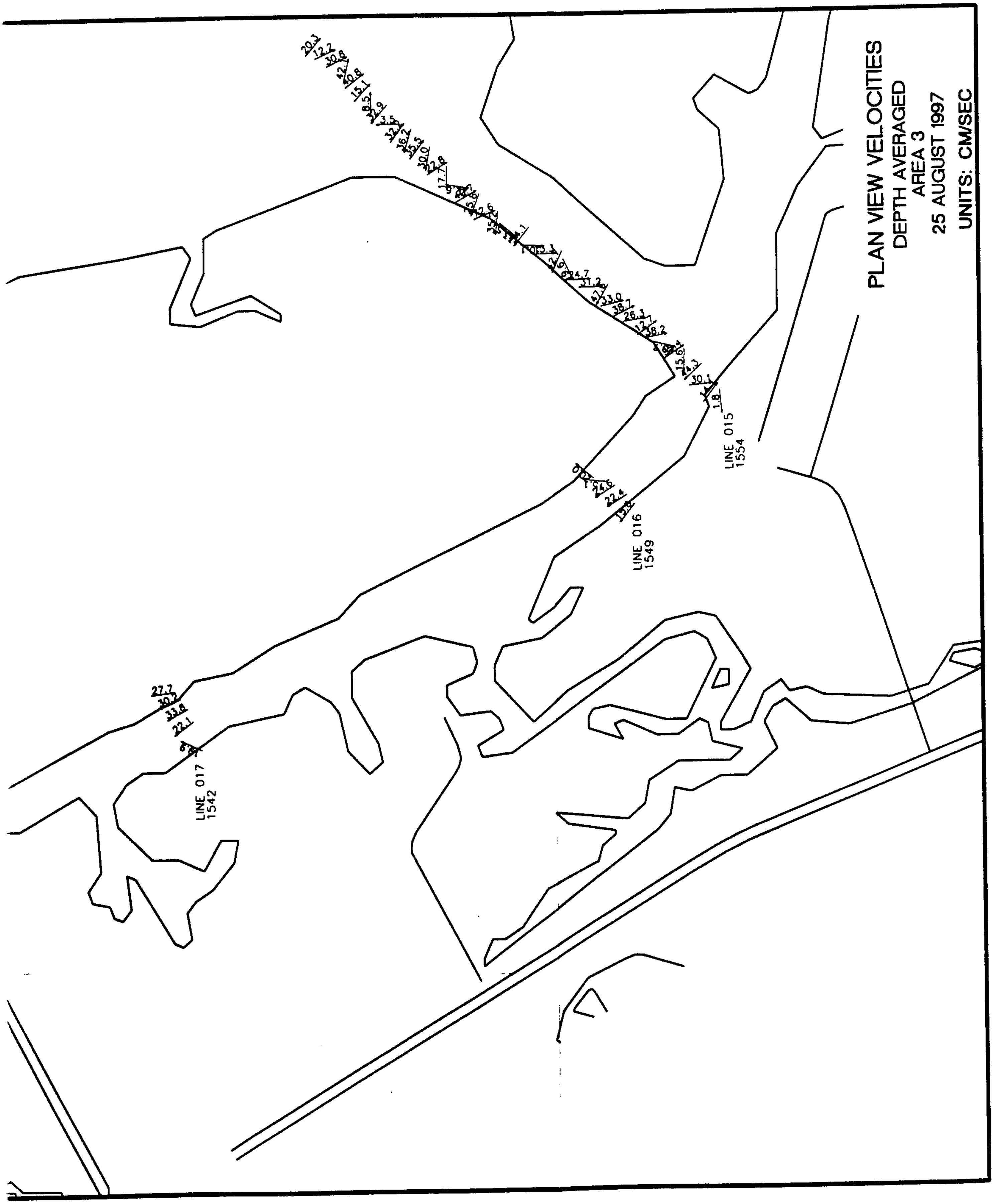
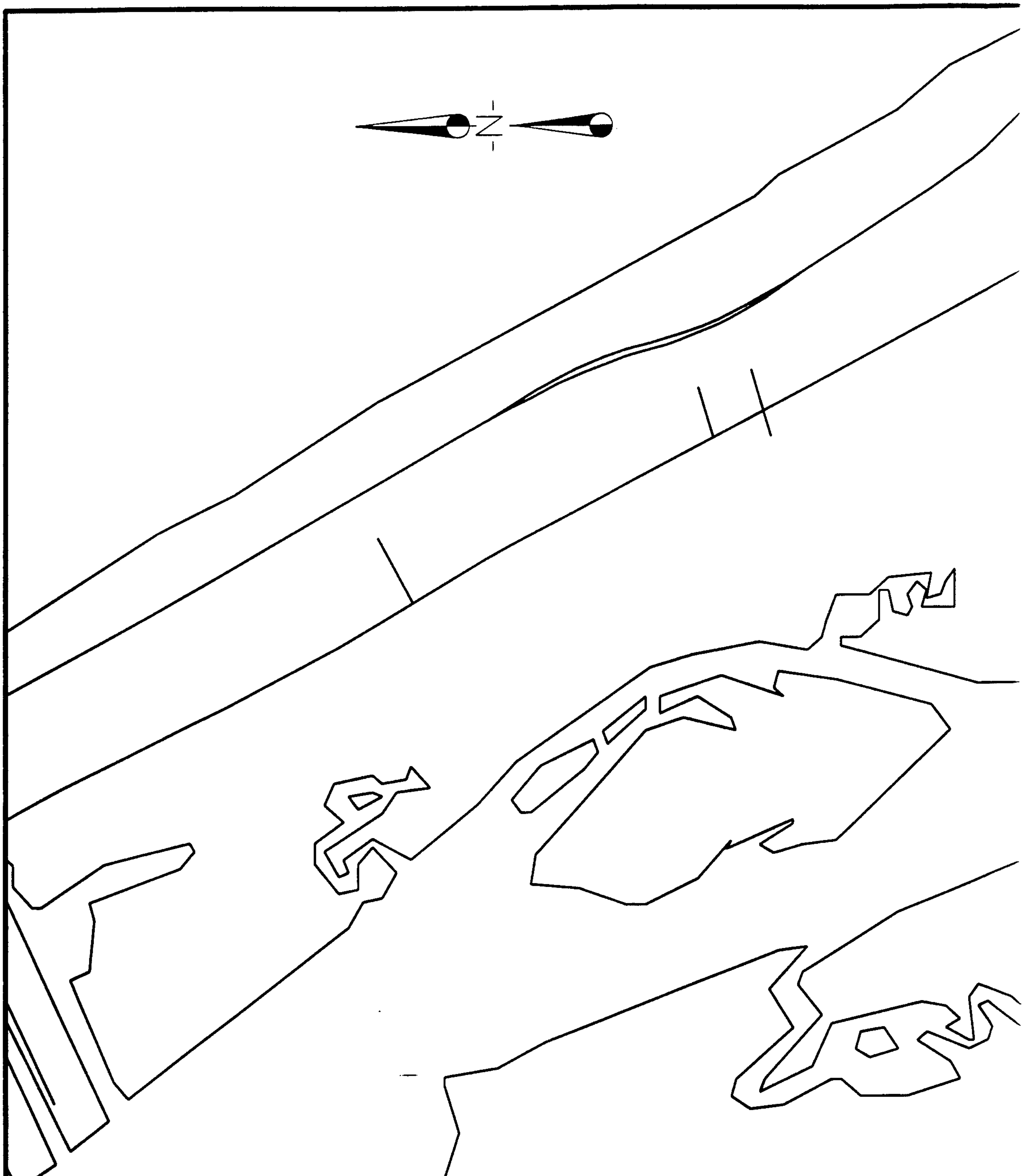
LINE 027
1433
LINE 232
1503
LINE 019
1530
LINE 018
1537
LINE 029
1411

1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 3
25 AUGUST 1997
UNITS: CM/SEC
LINE 015
1554
LINE 016
1549
LINE 017
1542

(2)

Plate A6



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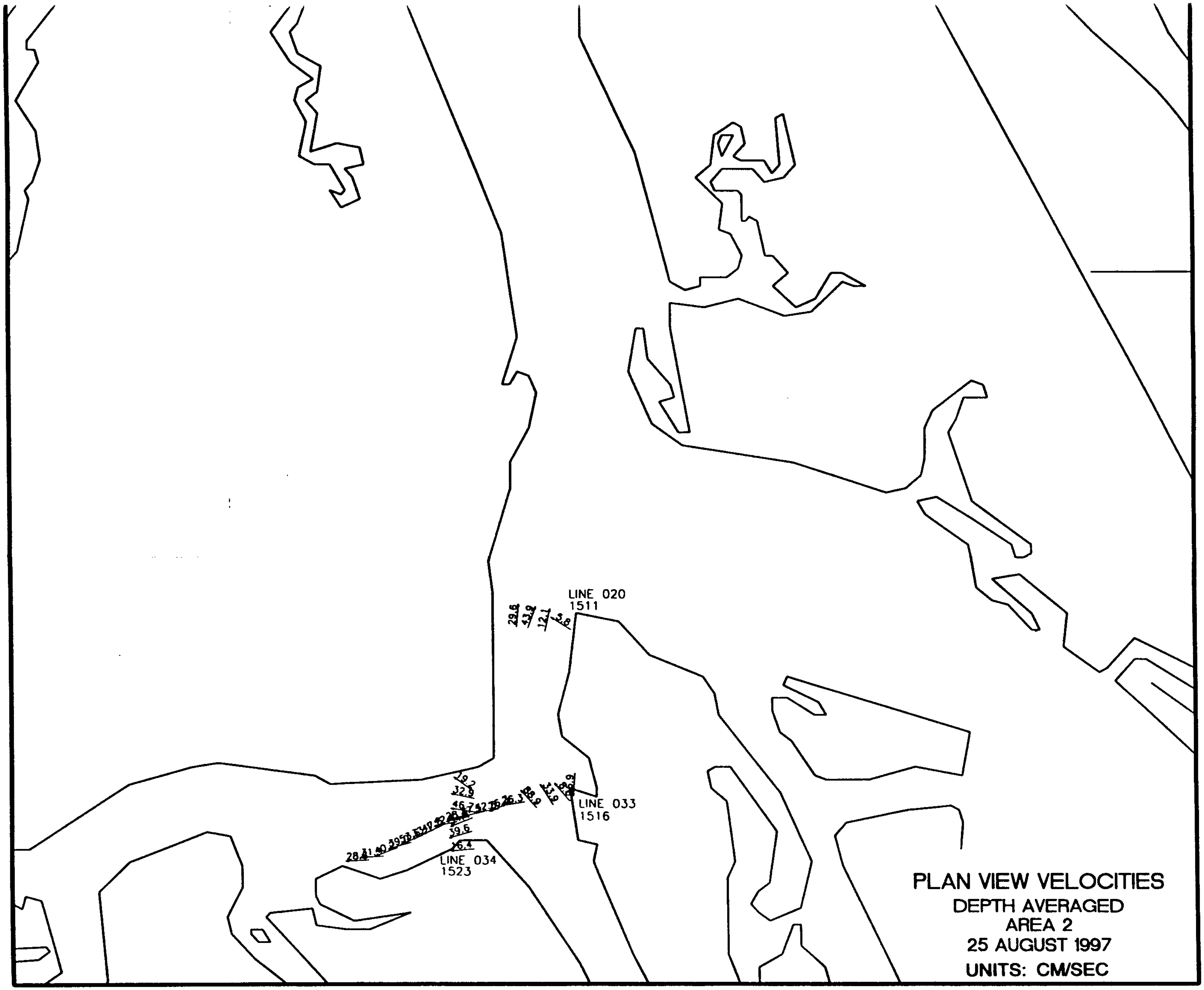

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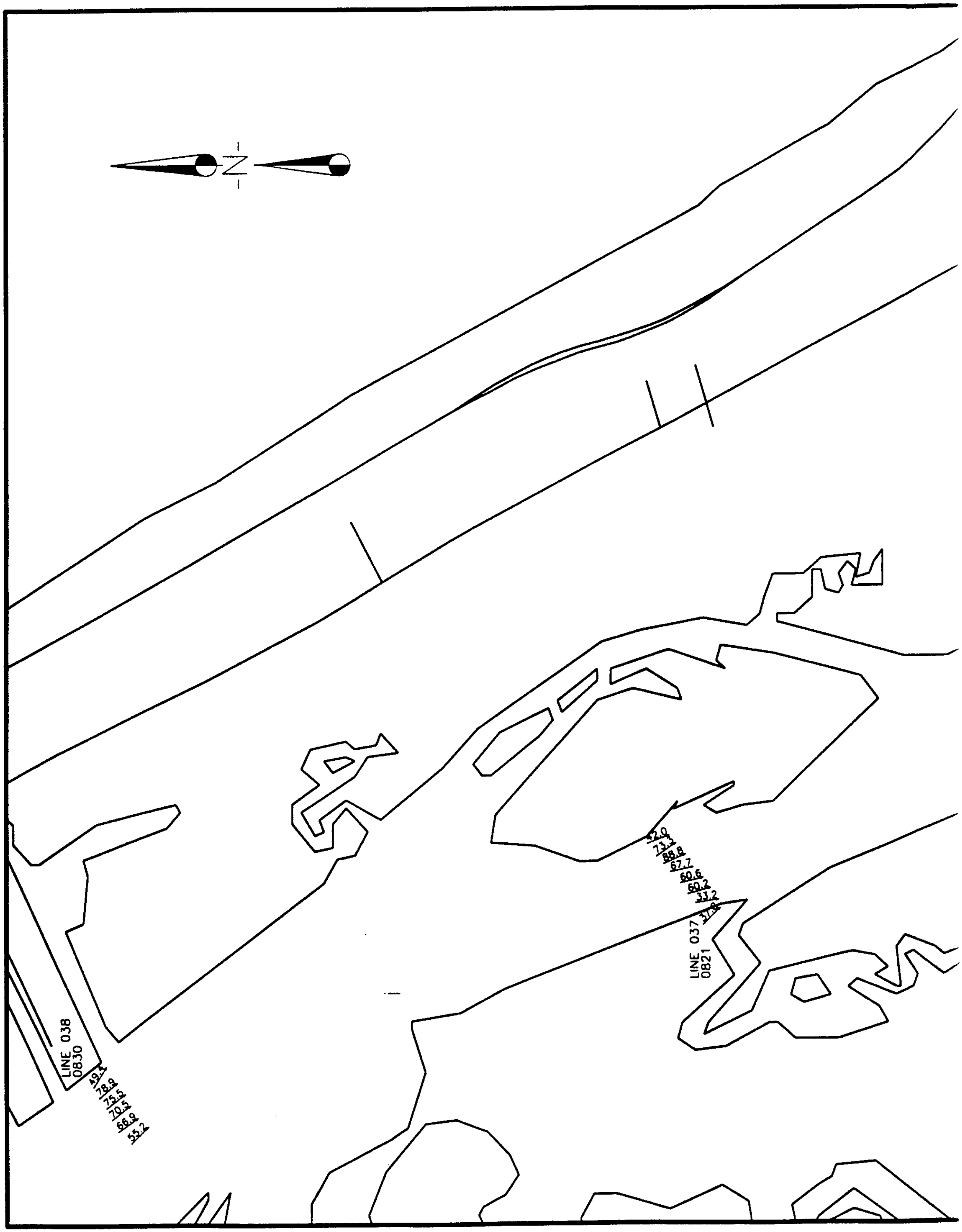
1511
29.6
43.9
12.1
5.8
LINE 033
1516
19.2
32.9
39.6
26.4
LINE 034
1523
28.4
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
25 AUGUST 1997
UNITS: CM/SEC

②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LINE 037
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37.8
LINE 03B
0830
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78.9
75.5
70.5
66.9
55.2

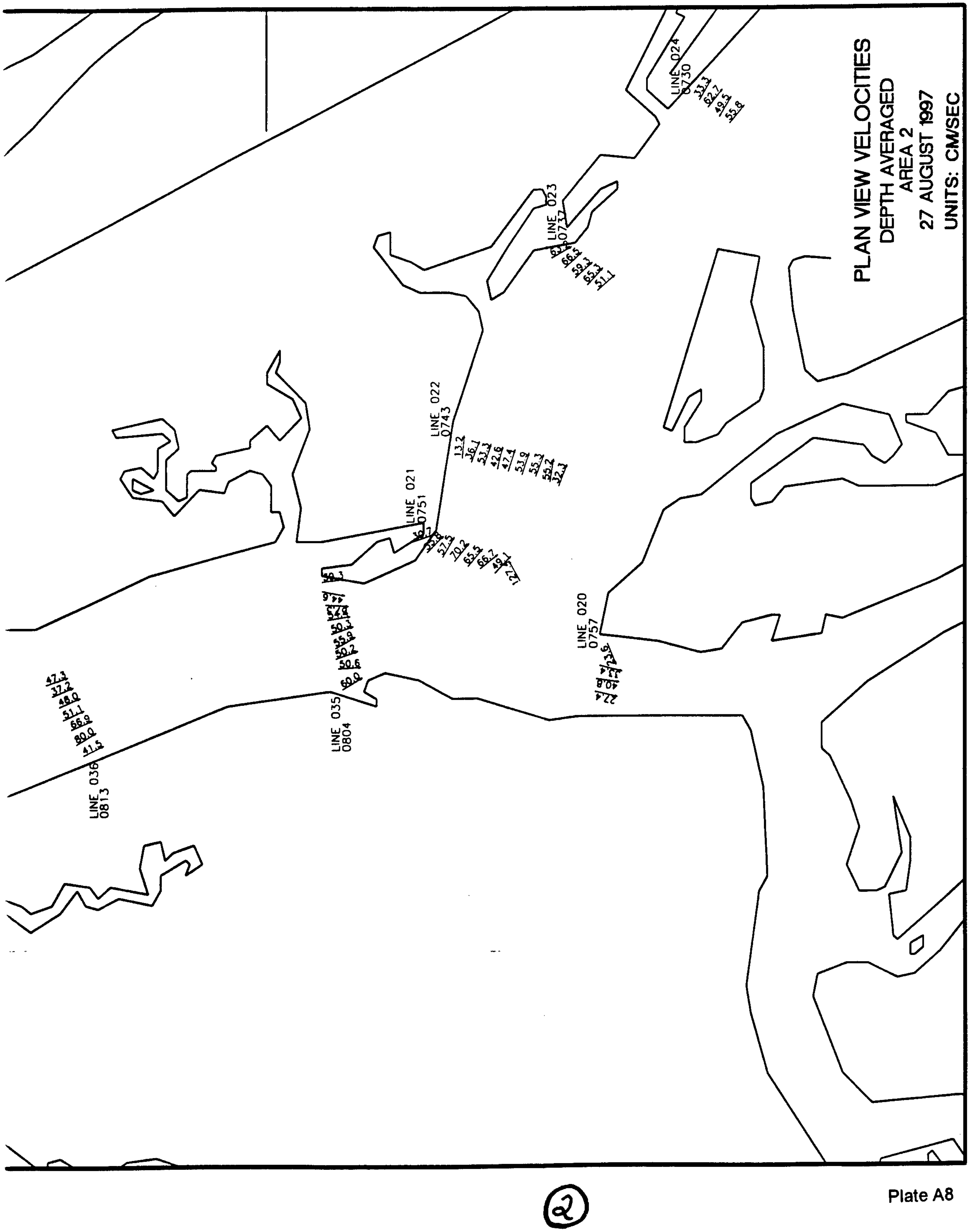
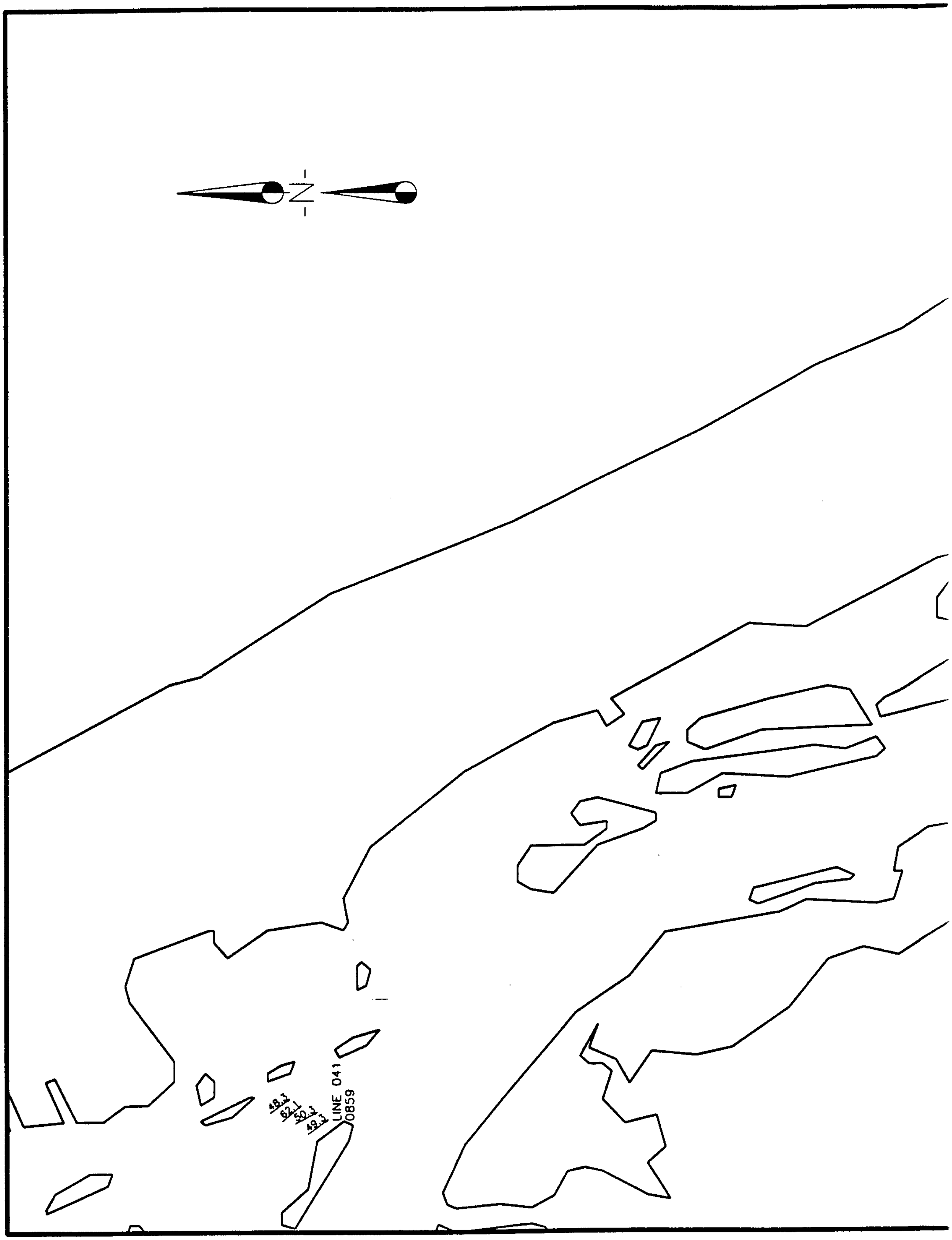

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
27 AUGUST 1997
UNITS: CM/SEC
LINE 024
0730
33.3
62.7
49.5
55.8
LINE 023
0737
LINE 022
0743
13.2
36.1
53.1
42.6
47.4
53.9
55.3
55.2
32.3
LINE 021
0751
LINE 020
0757
LINE 035
0804
LINE 036
0813
47.3
37.2
48.0
51.1
66.9
80.0
41.5

Plate A8

②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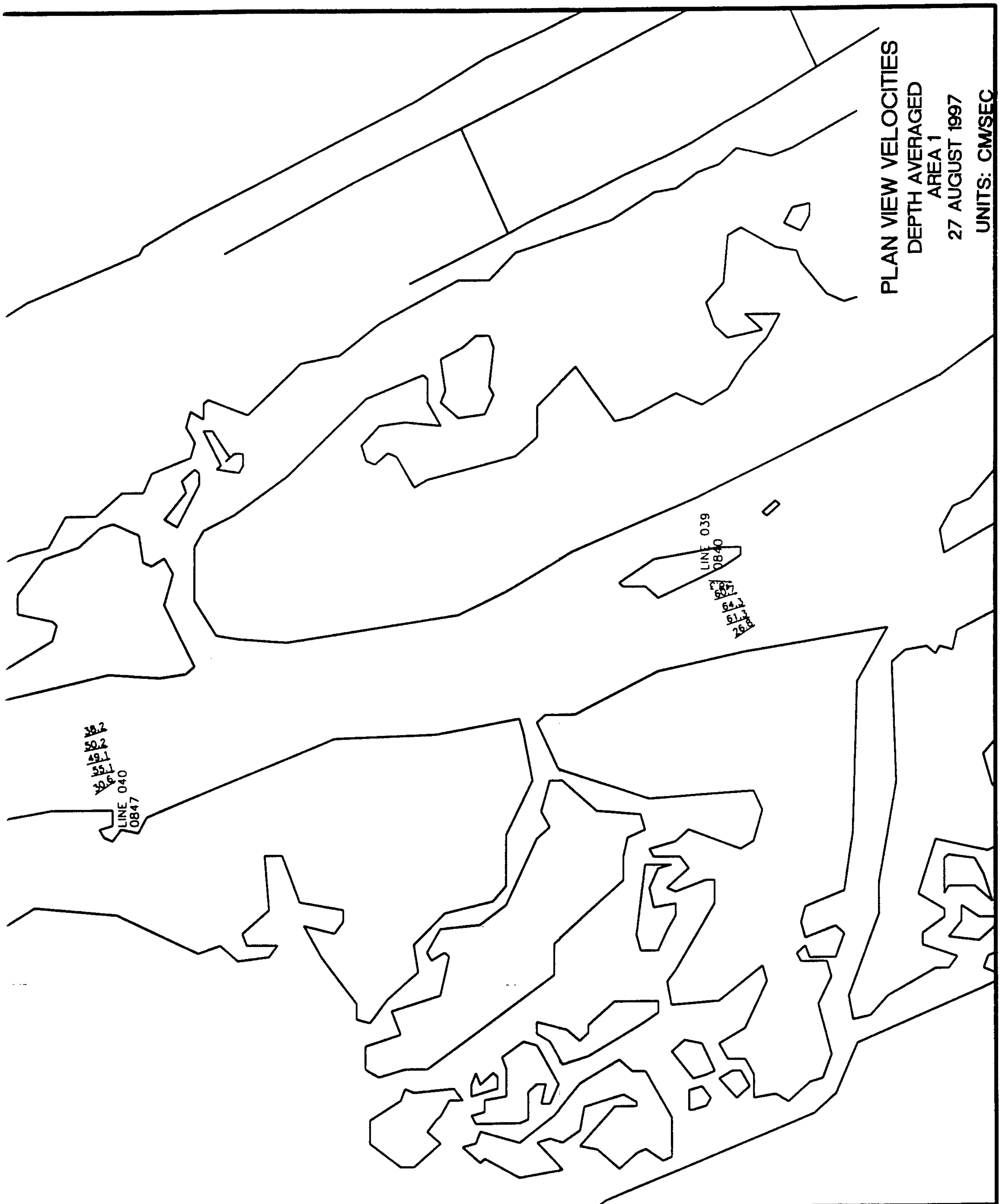
49.3


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 1
27 AUGUST 1997
UNITS: CM/SEC
LINE 039
0840
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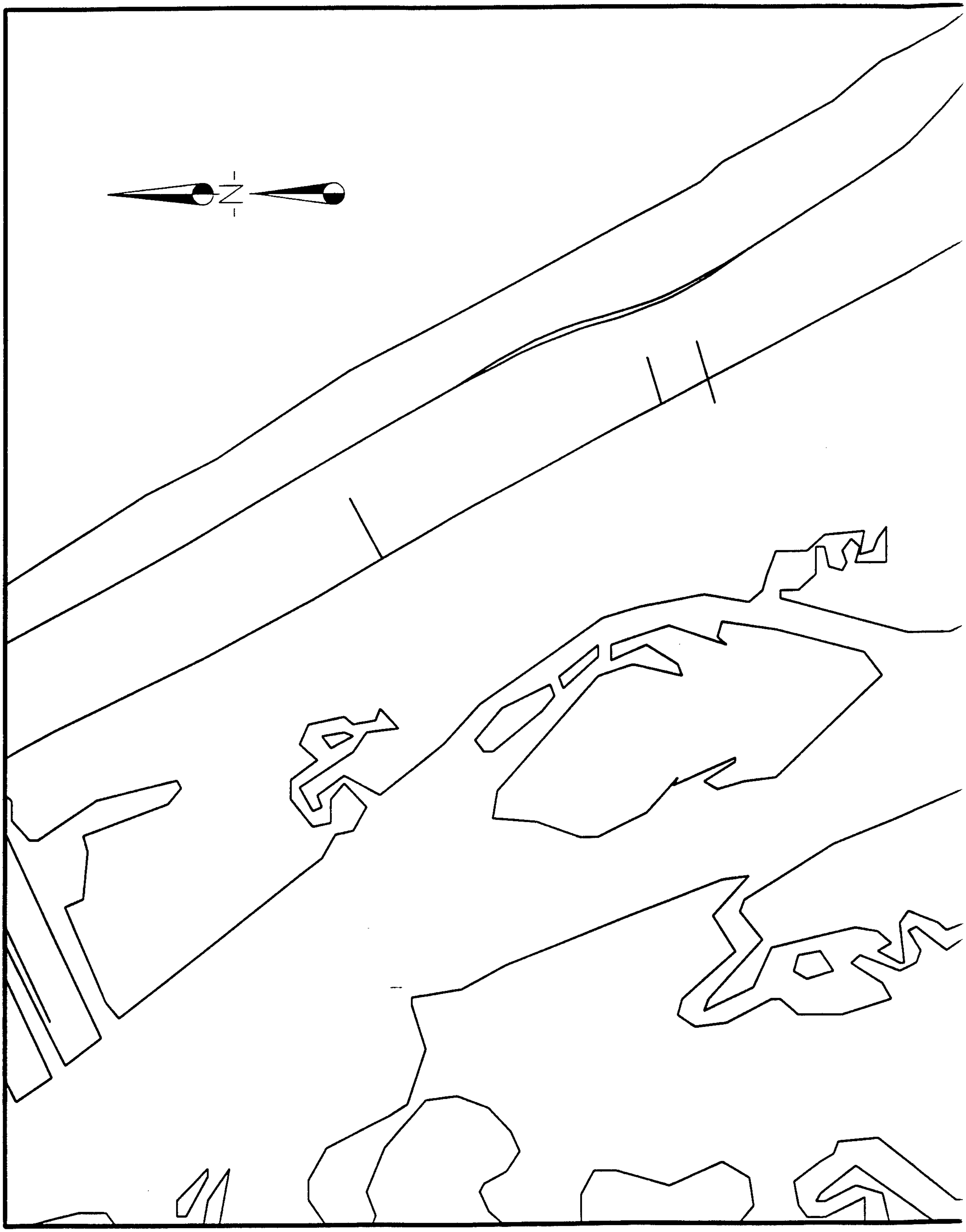
64.3
61.3
26.8
LINE 040
0847
38.2
50.2
49.1
55.1
30.6

2



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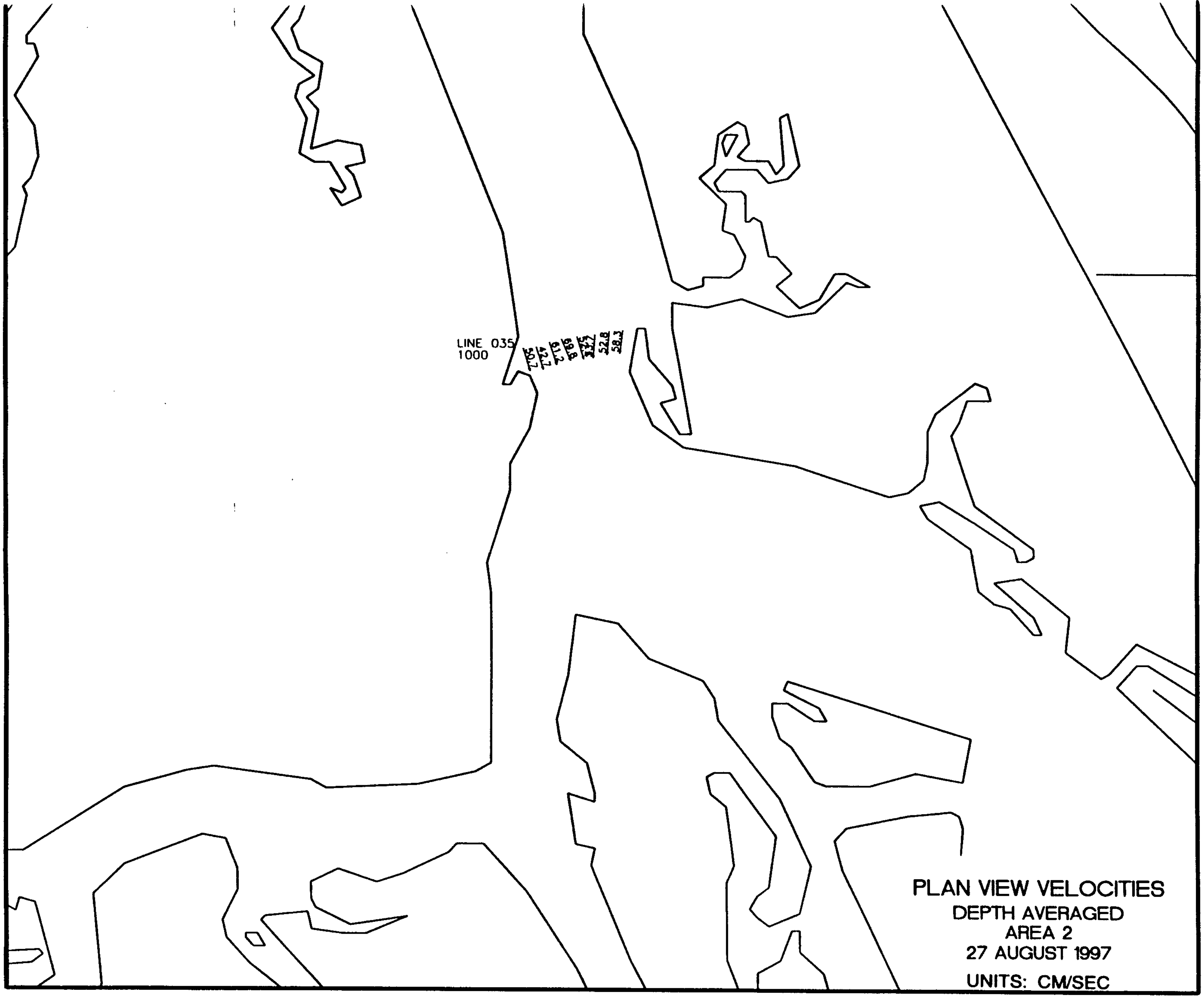
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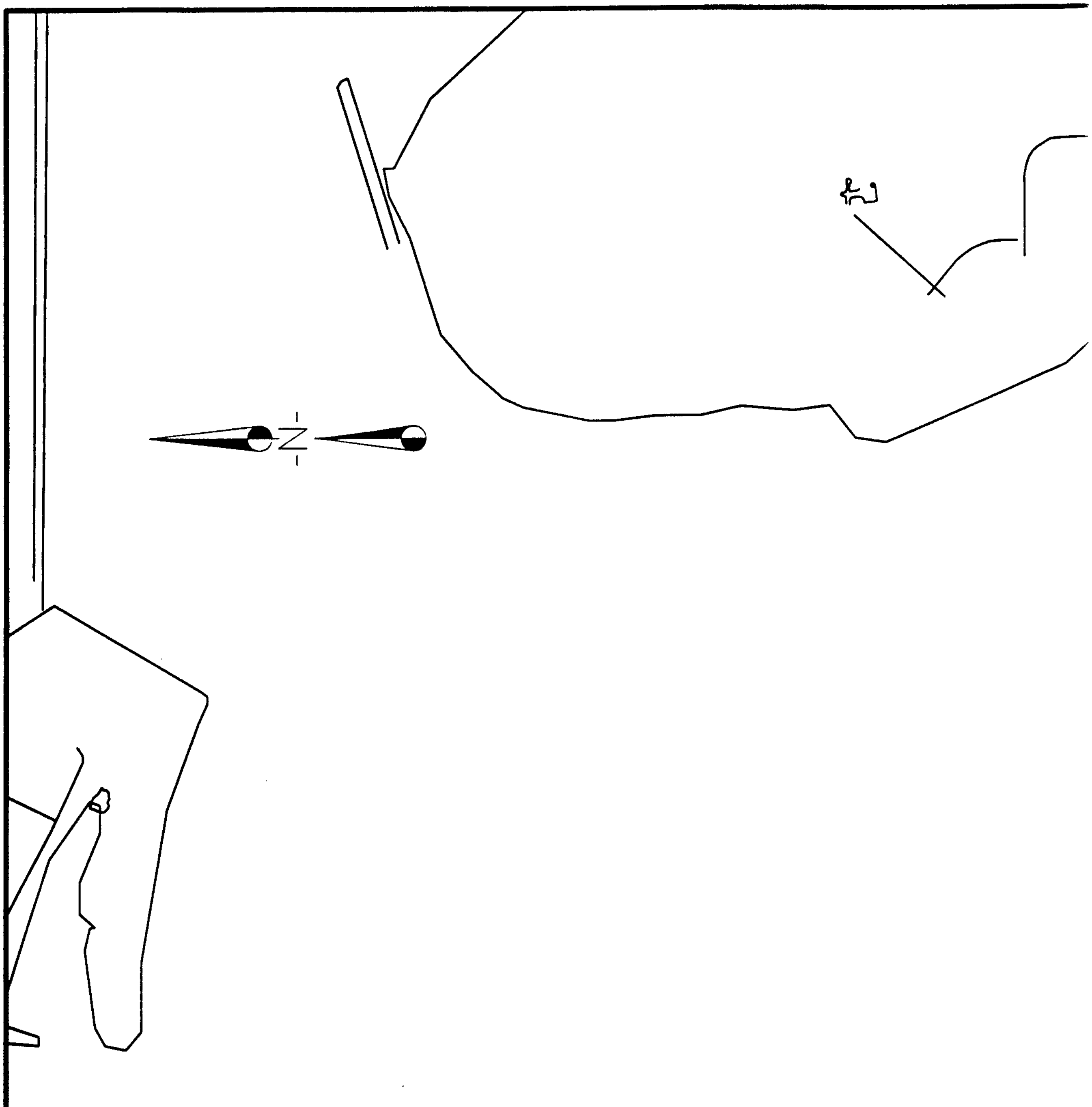
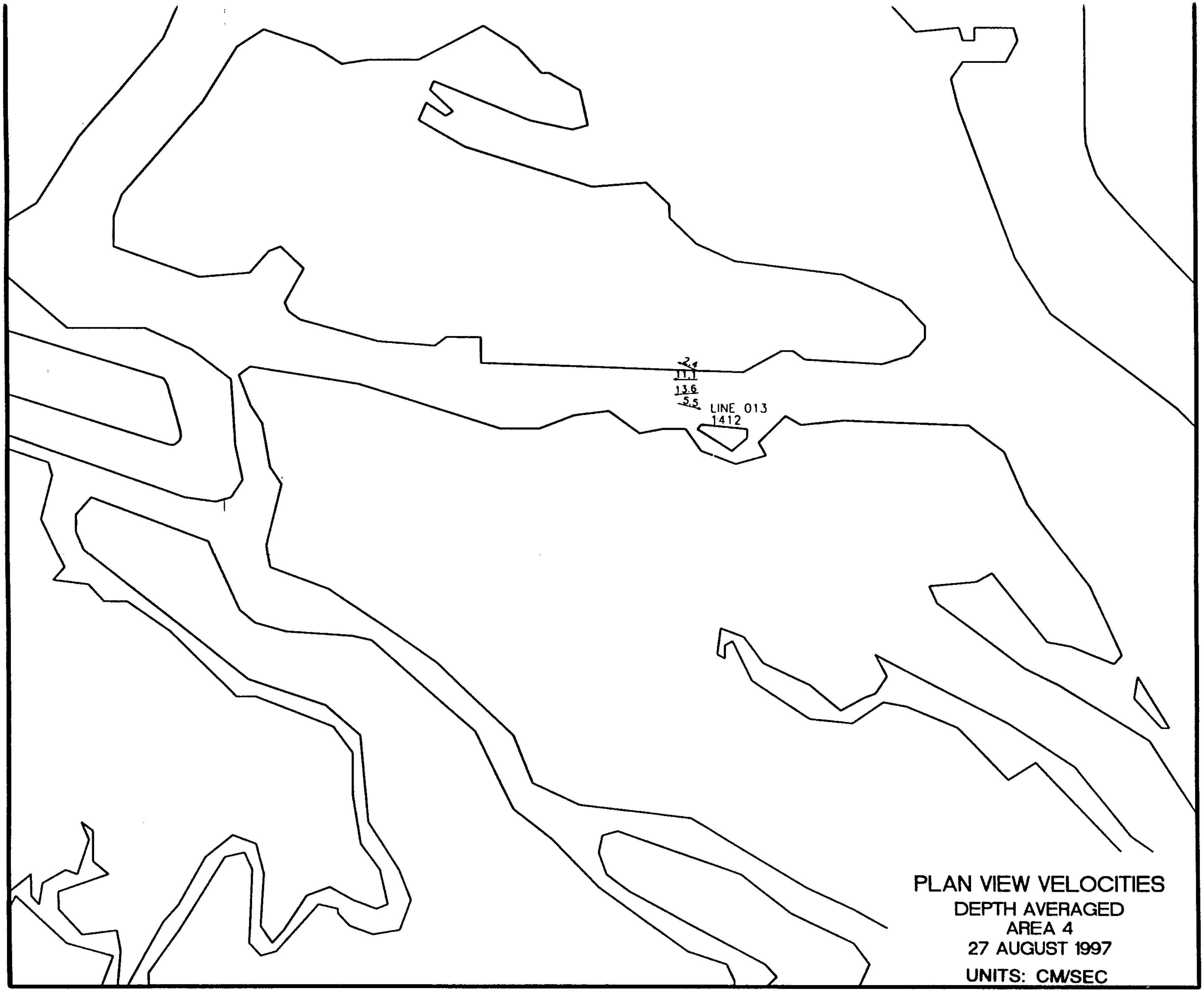
42.7
61.2
69.8
52.8
58.1
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
27 AUGUST 1997
UNITS: CM/SEC

2

Plate A10




2.4
11.1
13.6
5.5
LINE 013
1412
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
27 AUGUST 1997
UNITS: CM/SEC

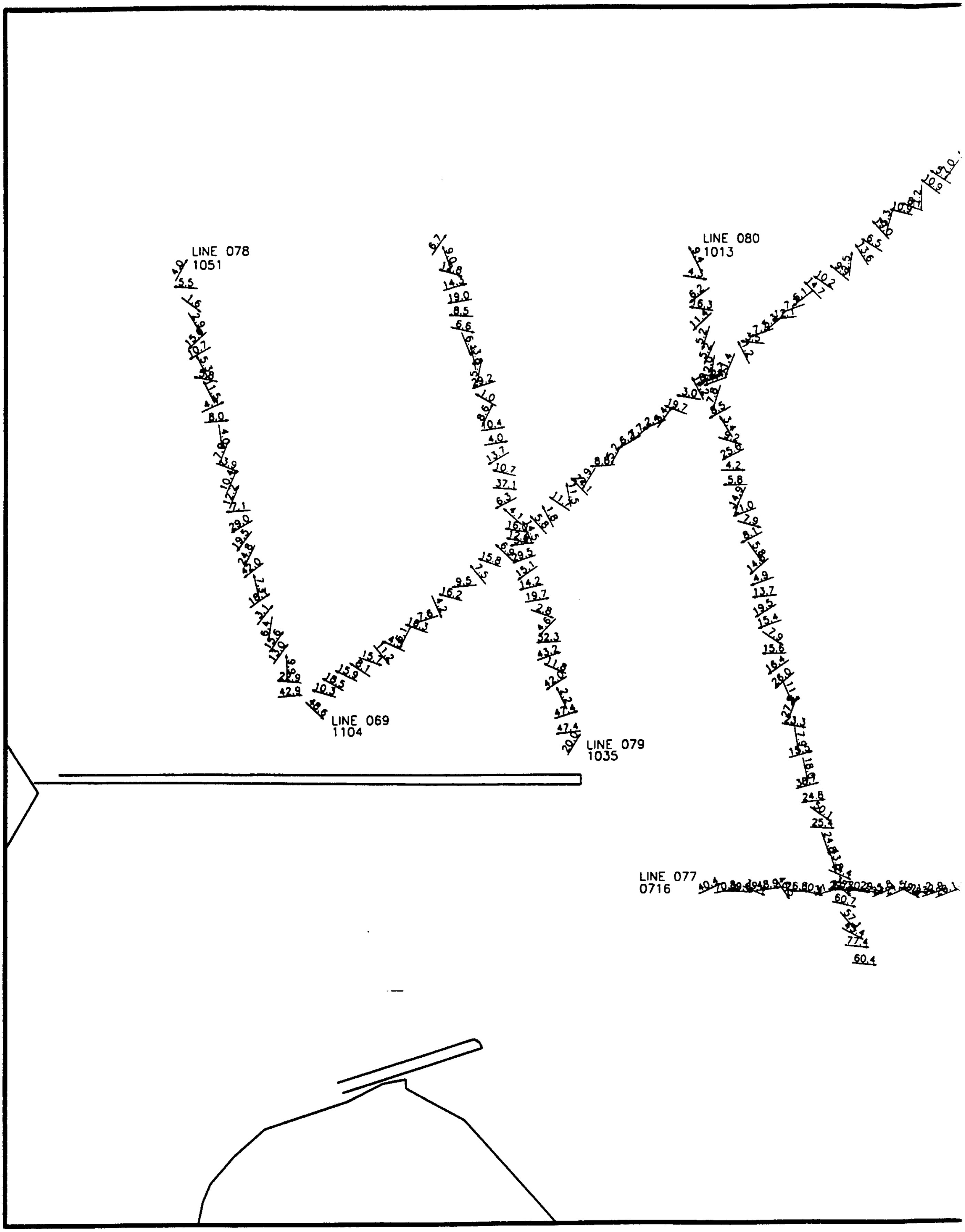
2

Plate A11


N
56.7
59.0
LINE 019
1504

33.7
41.3
40.5
44.3
26.3
LINE 017
1441
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 3
27 AUGUST 1997
UNITS: CM/SEC

2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LINE 080
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LINE 069
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LINE 079
1035
LINE 077
0716

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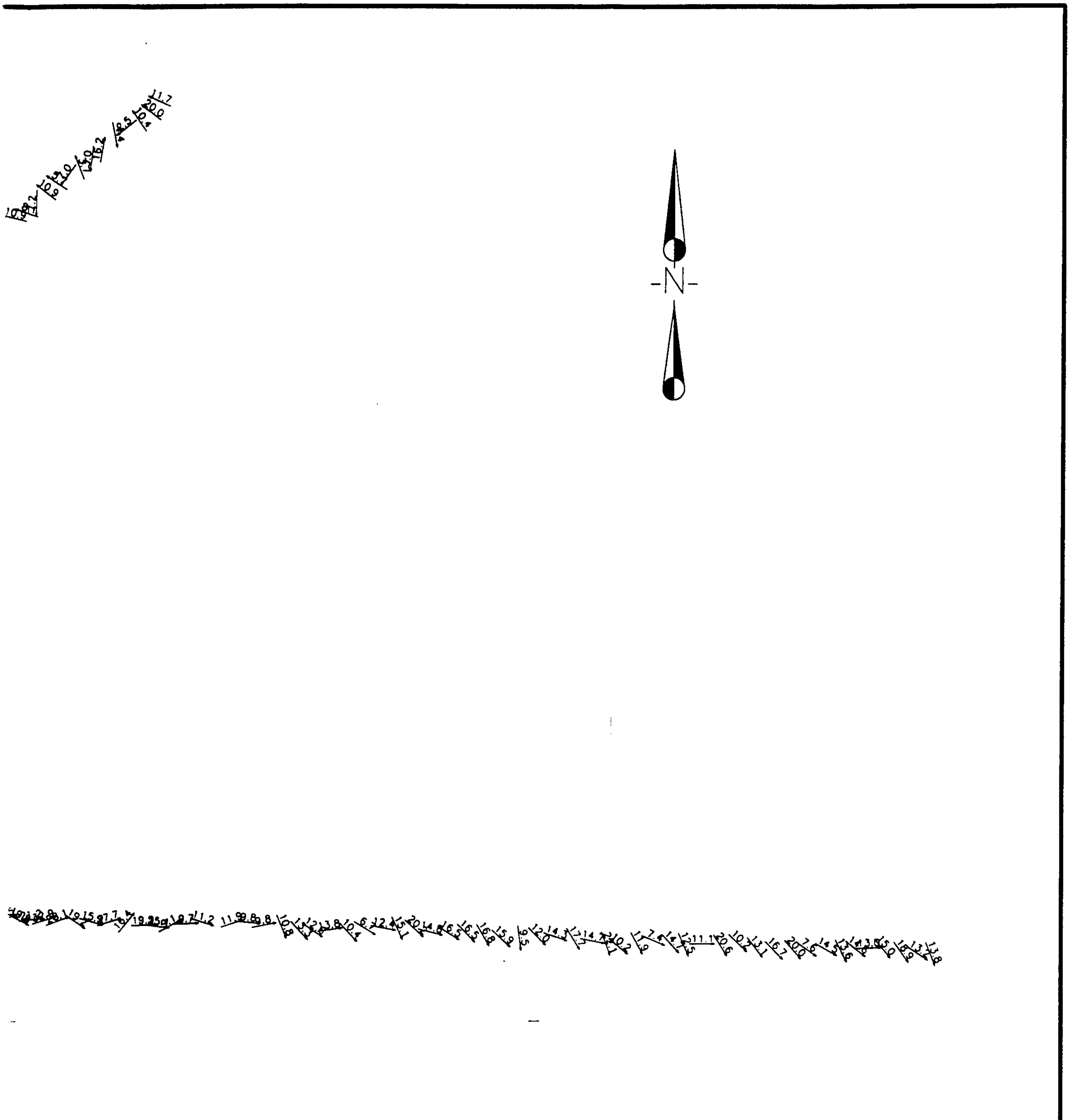
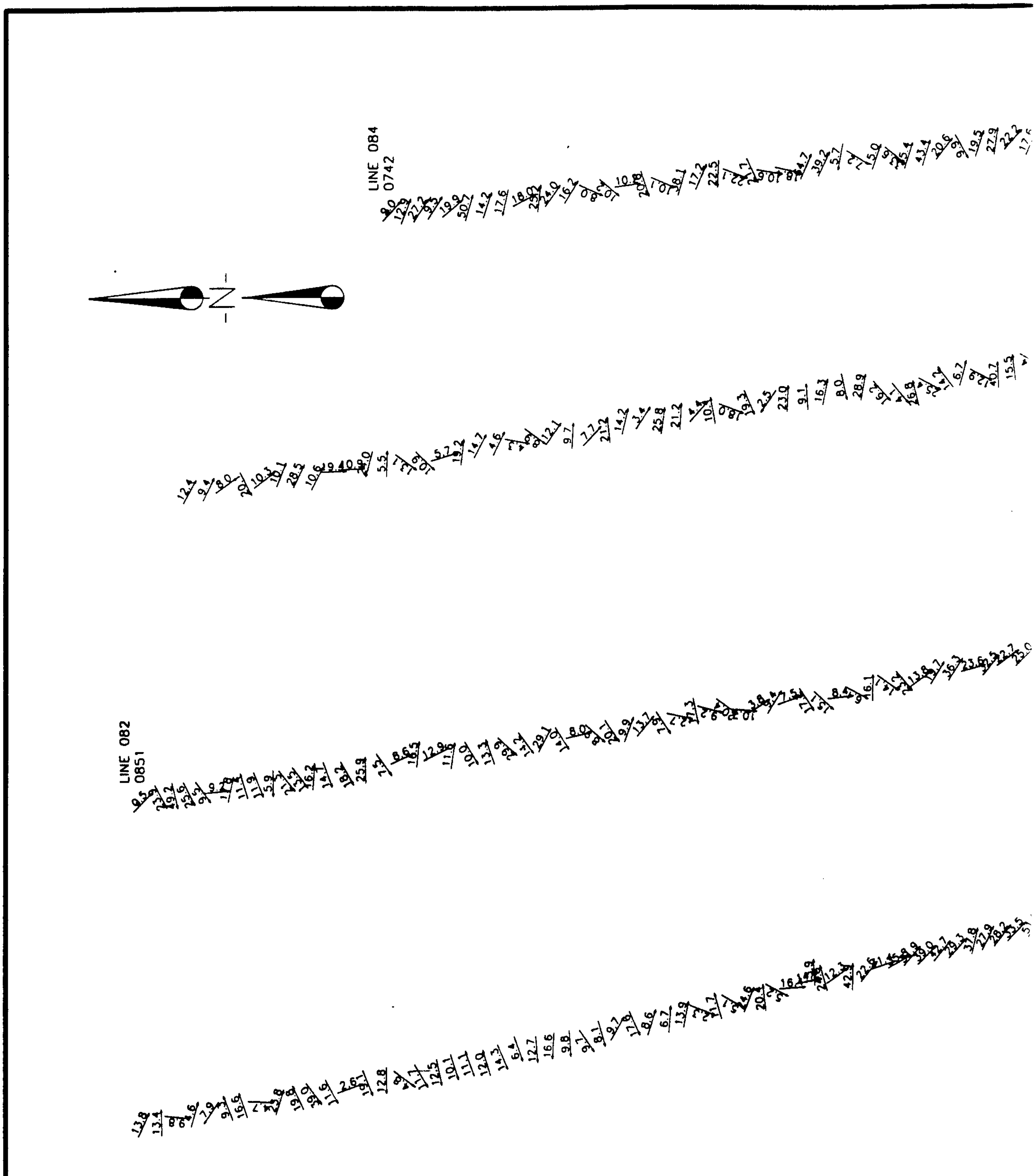


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 6
28 AUGUST 1997
UNITS: CM/SEC

2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LINE 082
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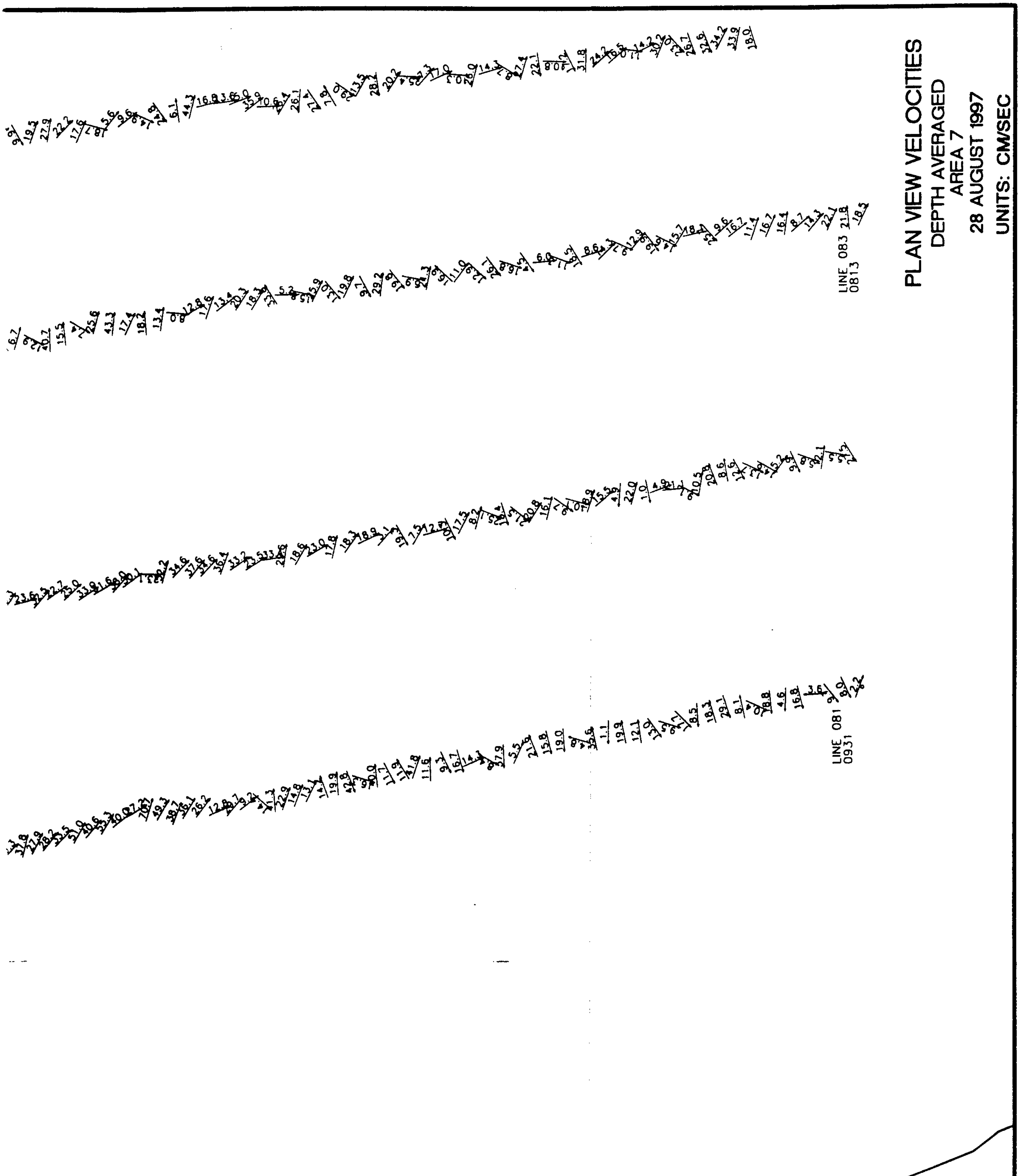
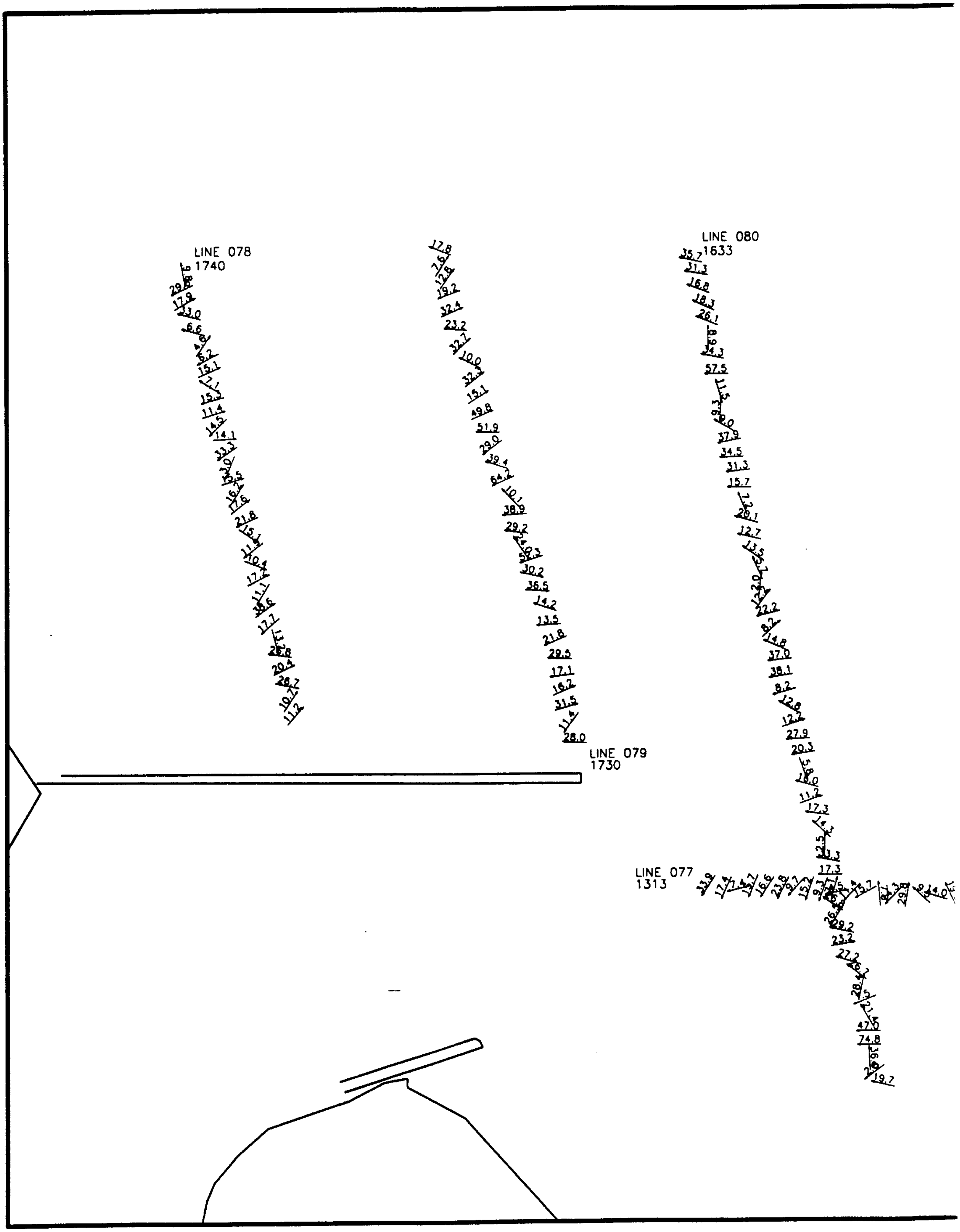

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 7
28 AUGUST 1997
UNITS: CM/SEC
LINE 083
0813
LINE 081
0931

2



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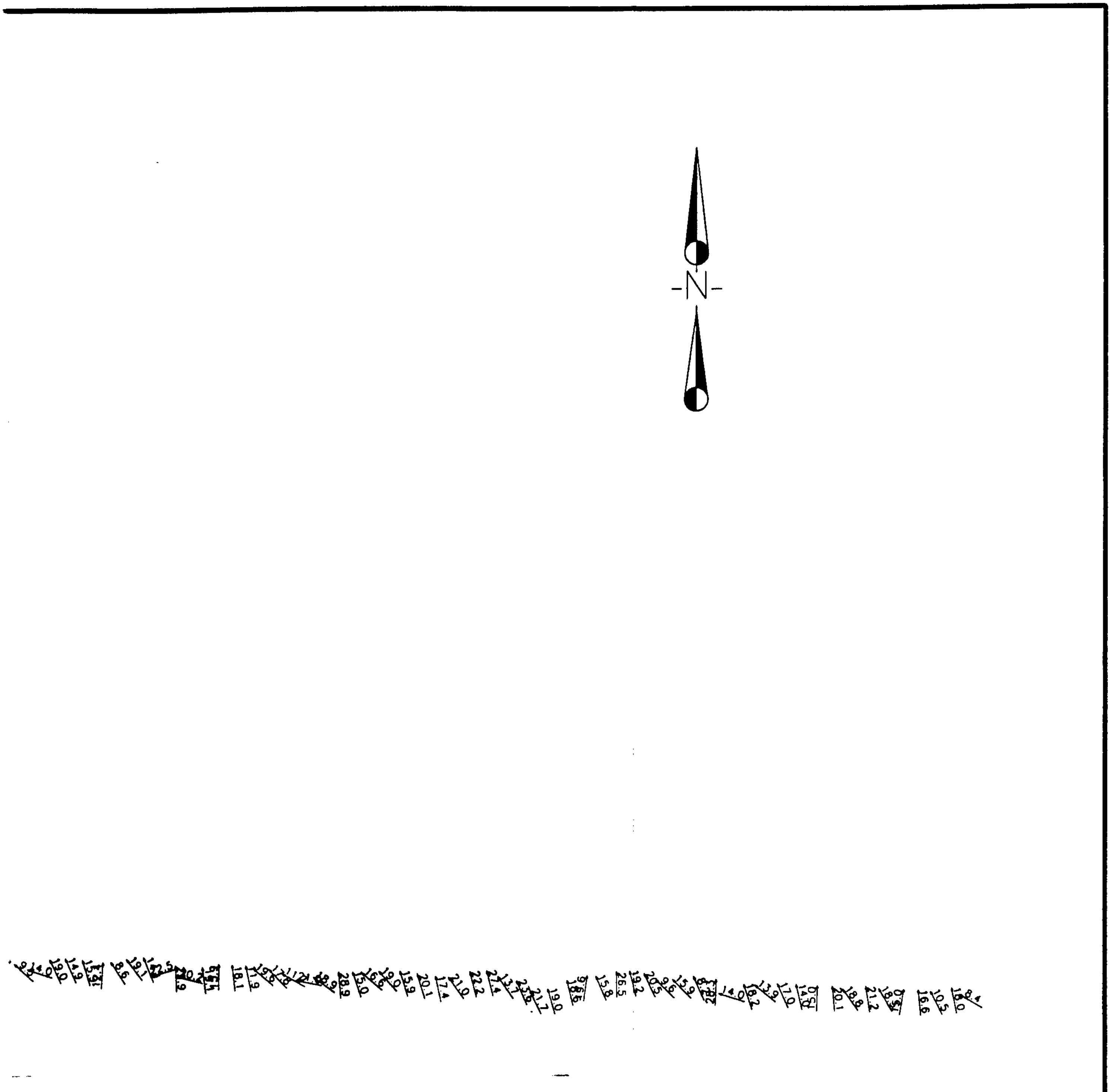
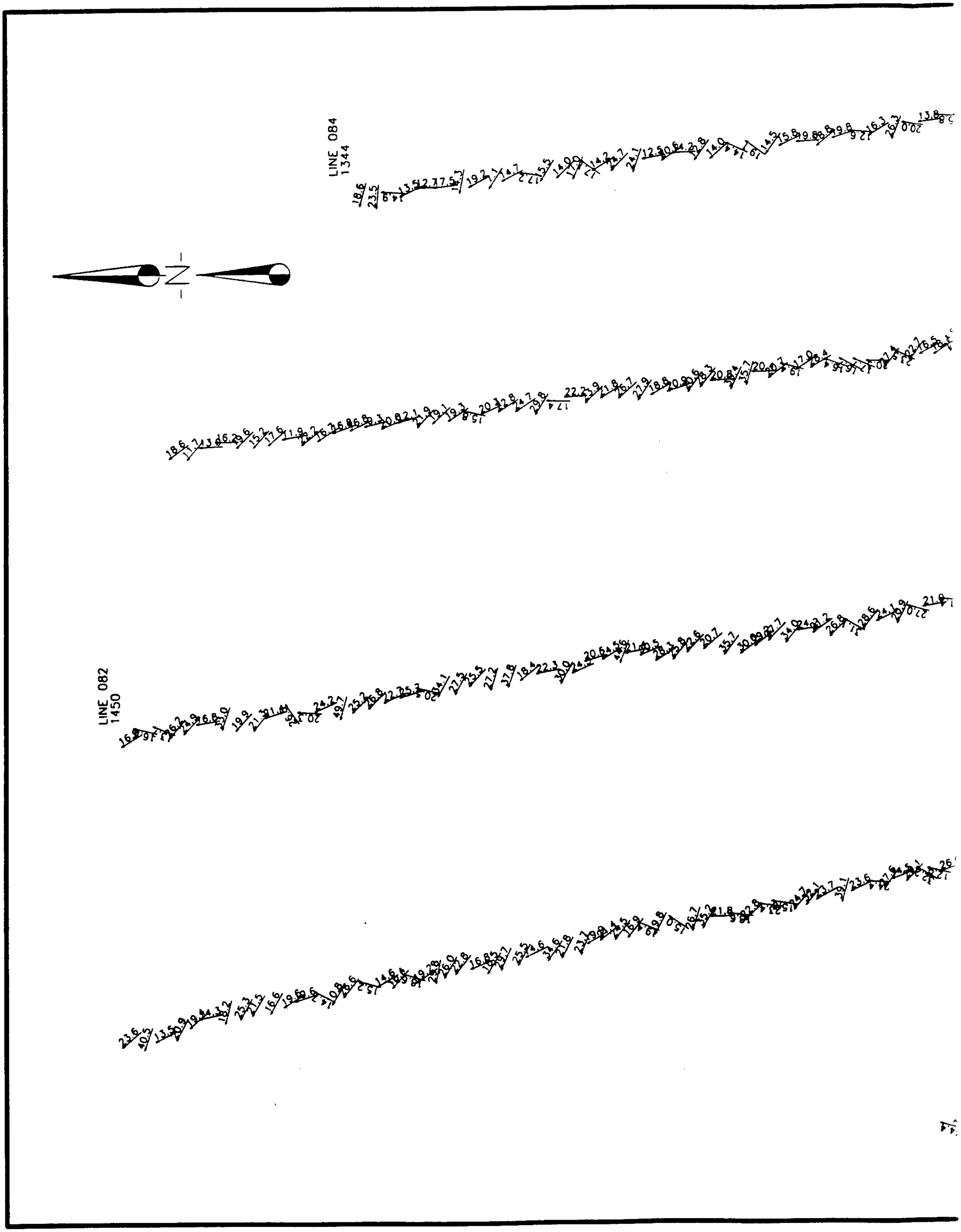


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 6
28 AUGUST 1997
UNITS: CM/SEC

2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LINE 082
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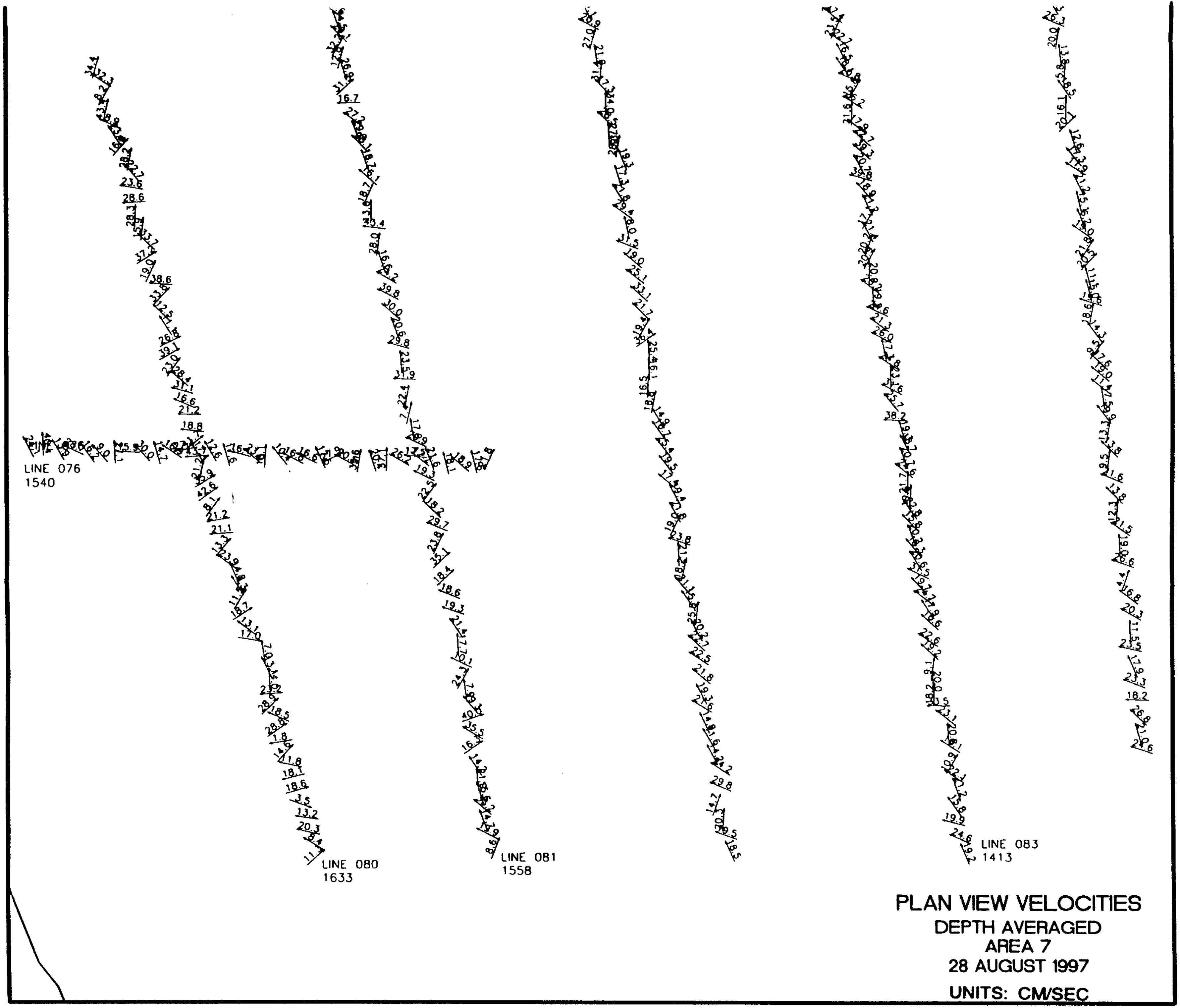

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 7
28 AUGUST 1997
UNITS: CM/SEC

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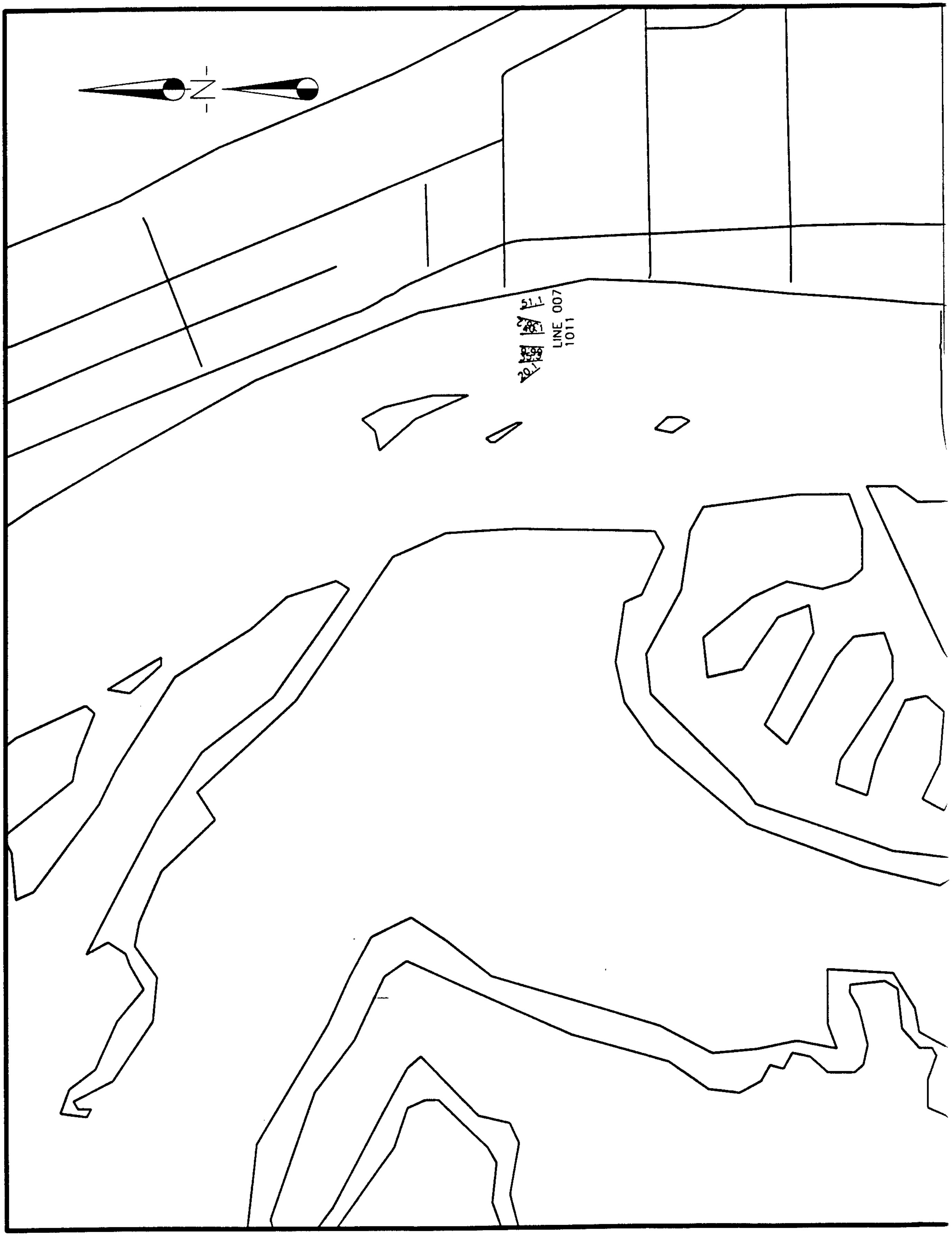

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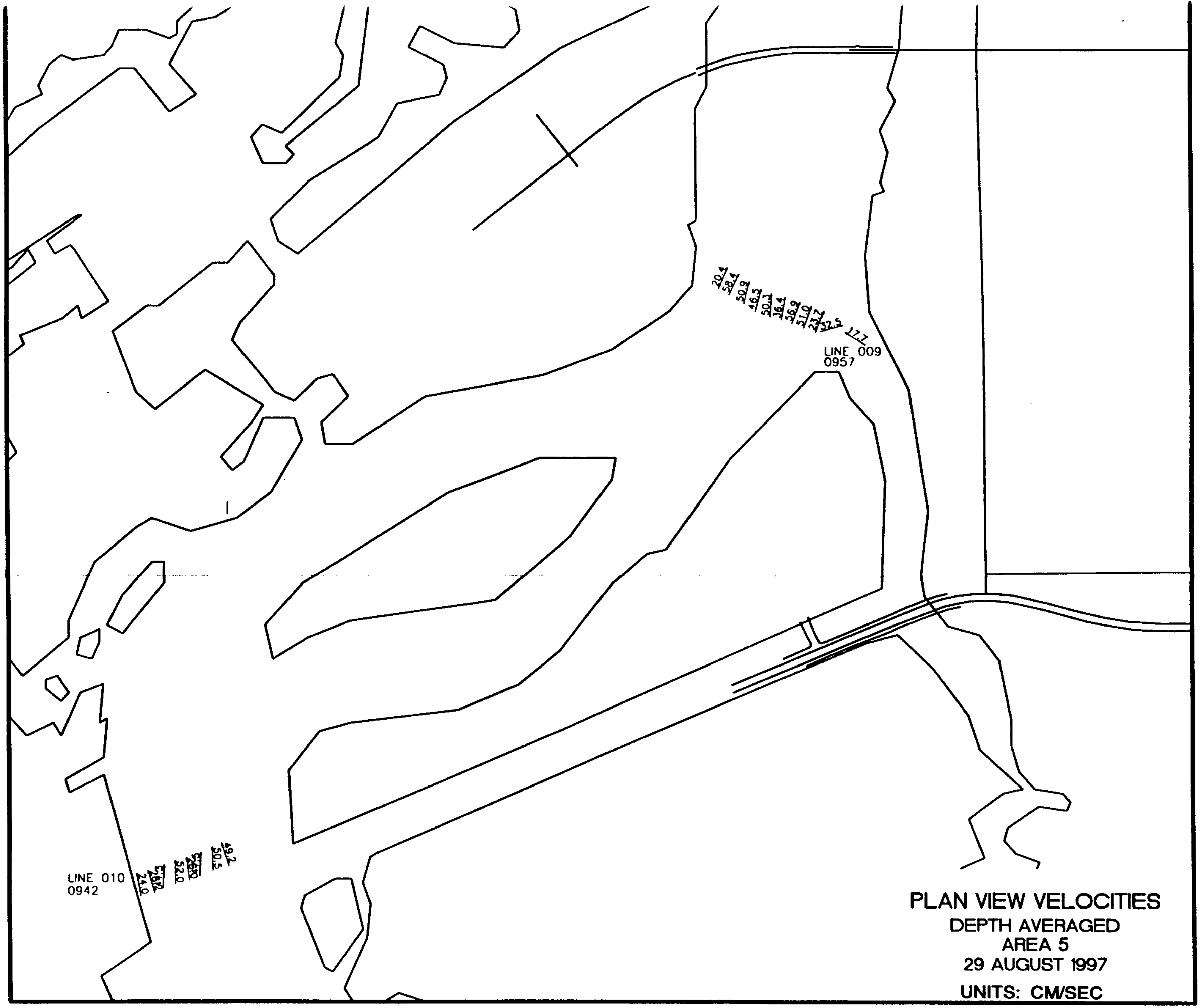

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 5
29 AUGUST 1997
UNITS: CM/SEC
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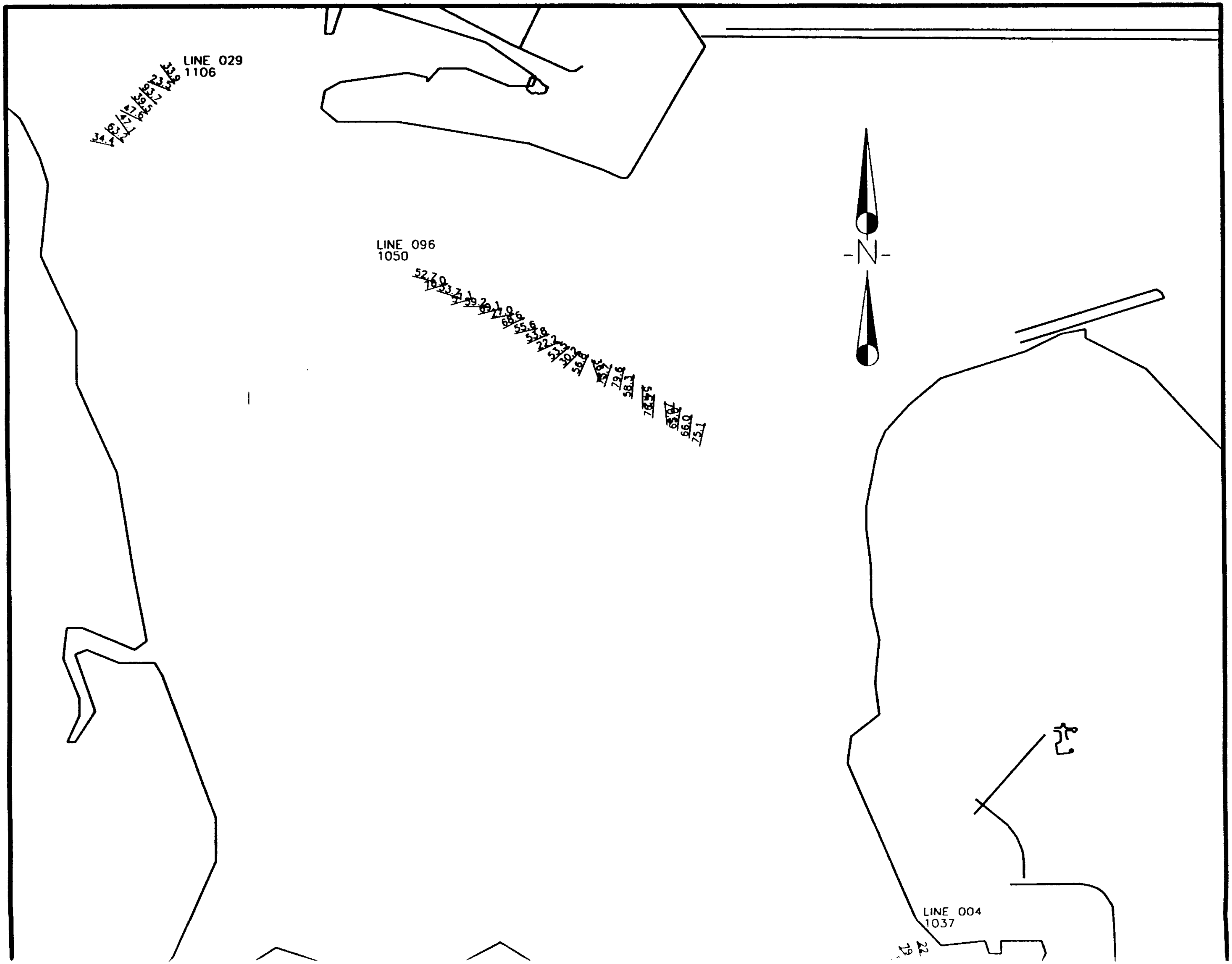
LINE 010
0942

2



LINE 029
1106
LINE 096
1050
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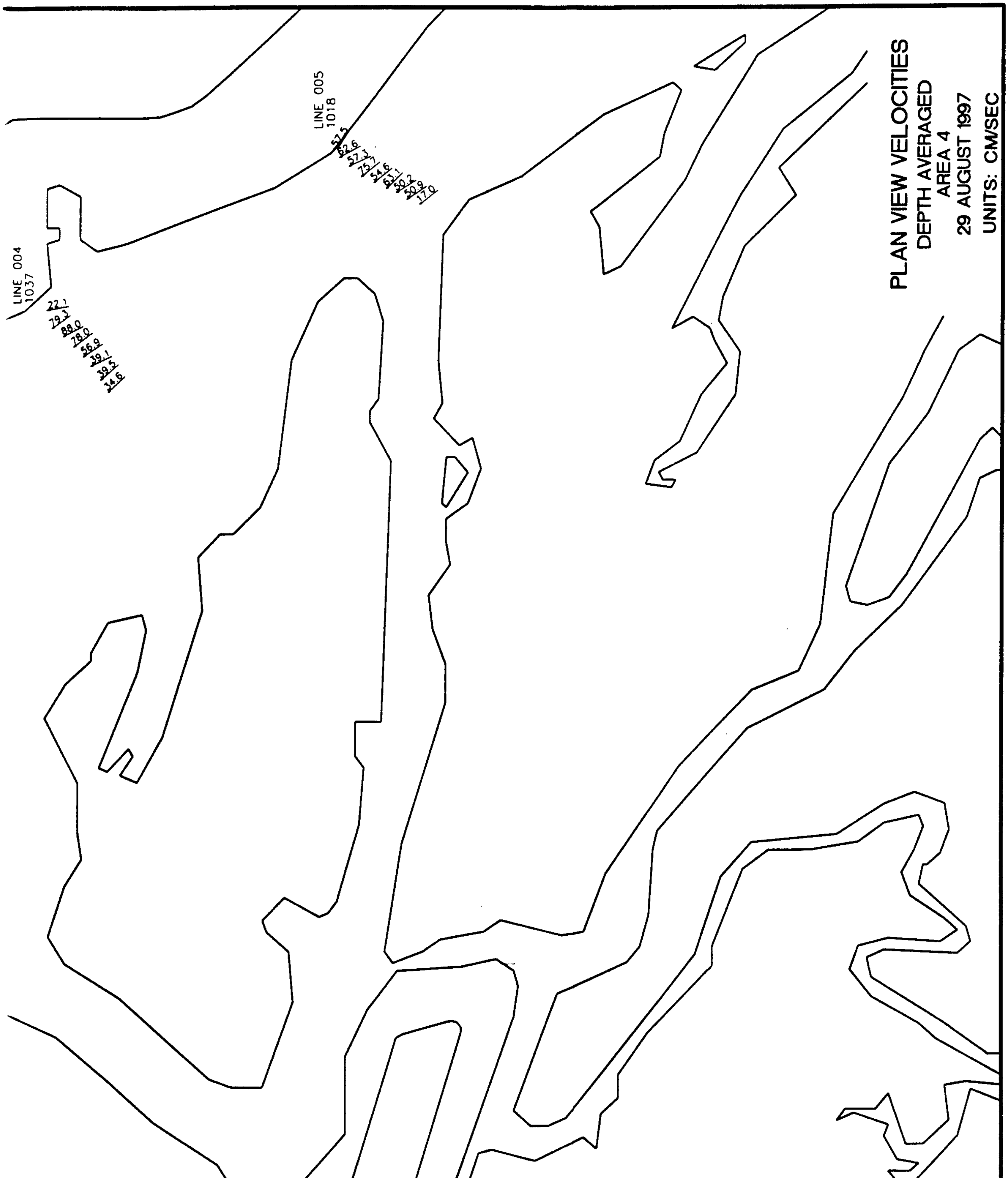
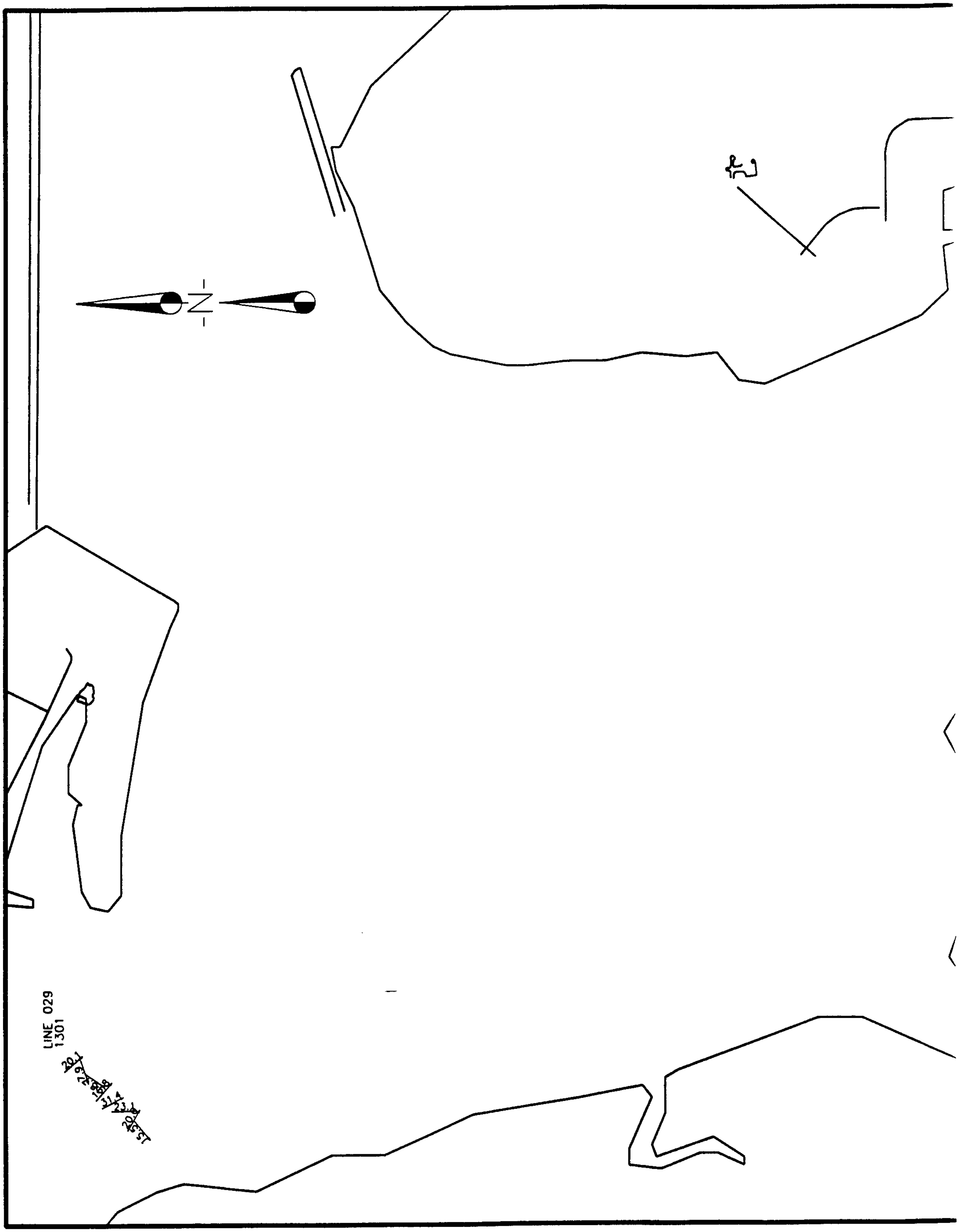
LINE 004
1037



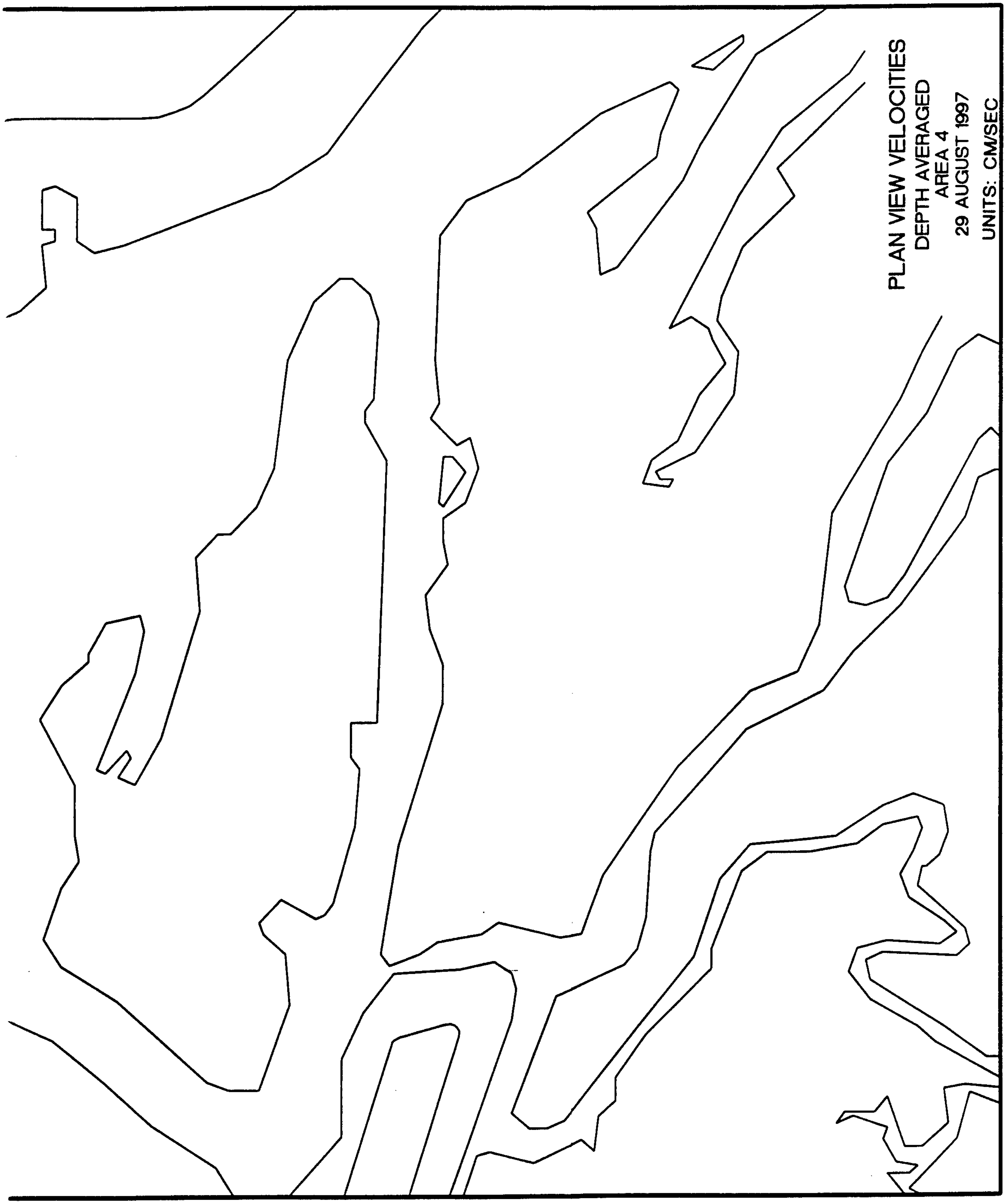
LINE 005
1018
57.5
62.6
57.3
75.7
54.6
63.1
50.2
50.9
17.0
LINE 004
1037
22.1
79.3
88.0
78.0
56.9
39.1
39.5
34.6
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
29 AUGUST 1997
UNITS: CM/SEC

2

Plate A18

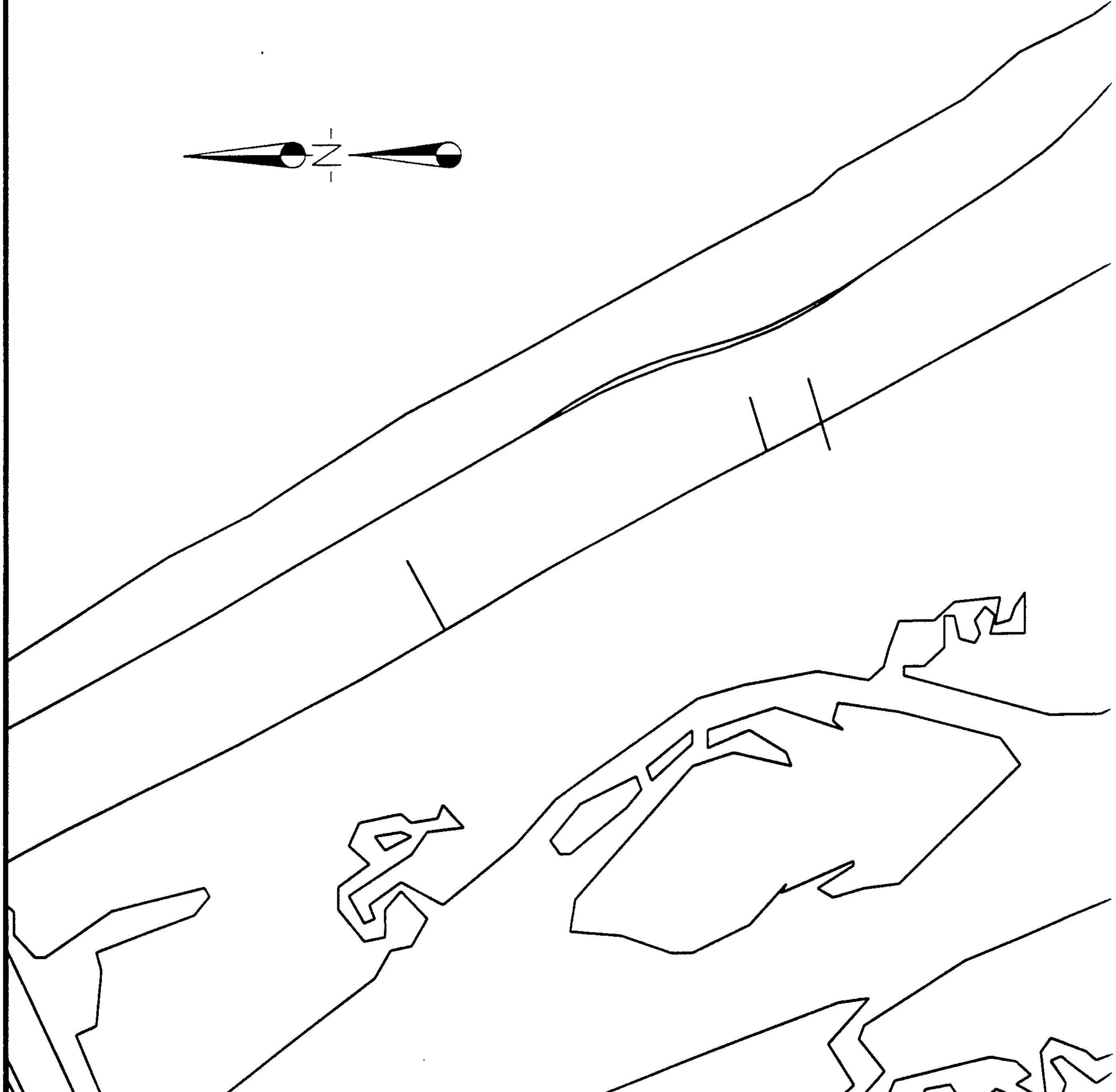


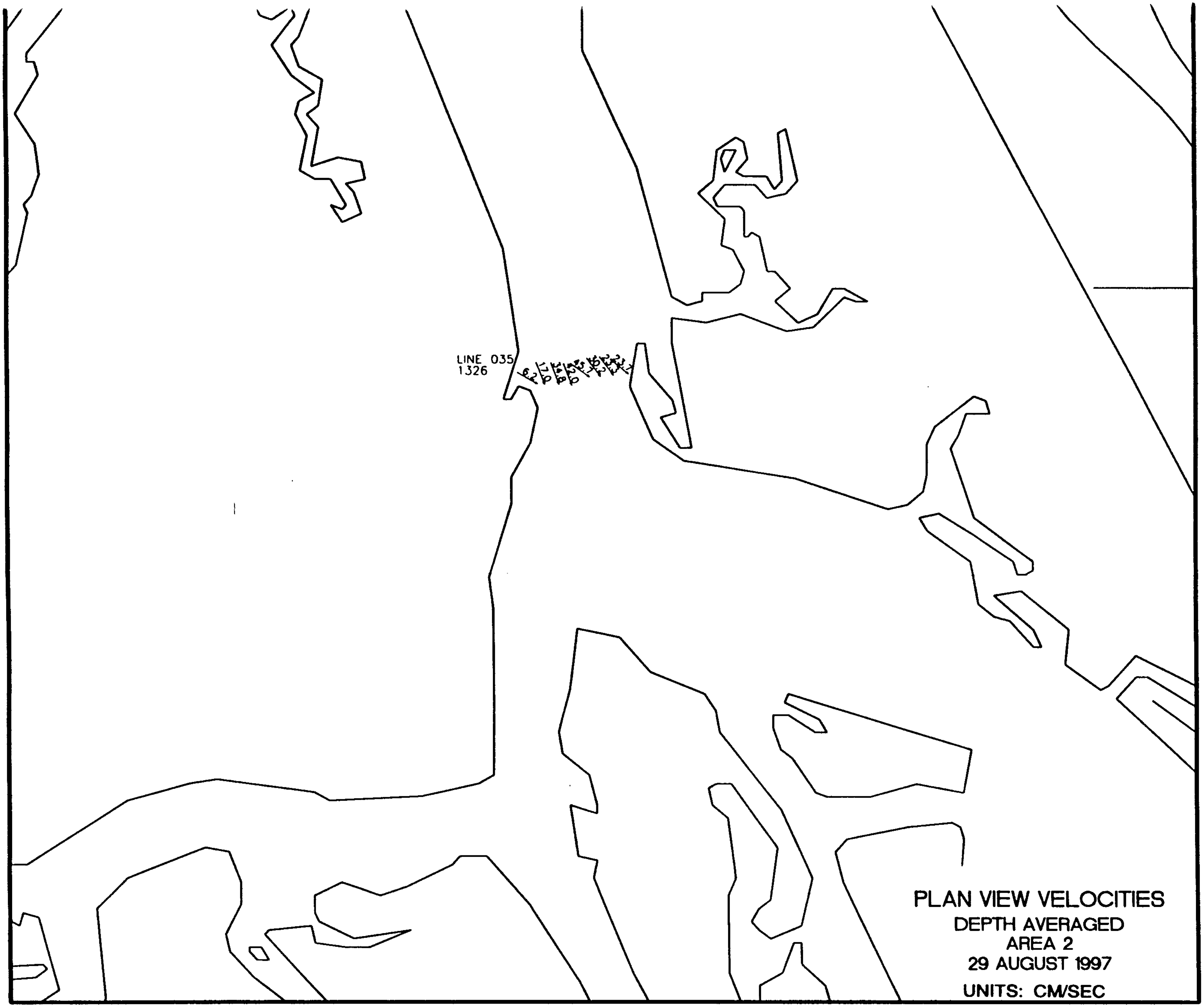
1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
29 AUGUST 1997
UNITS: CM/SEC

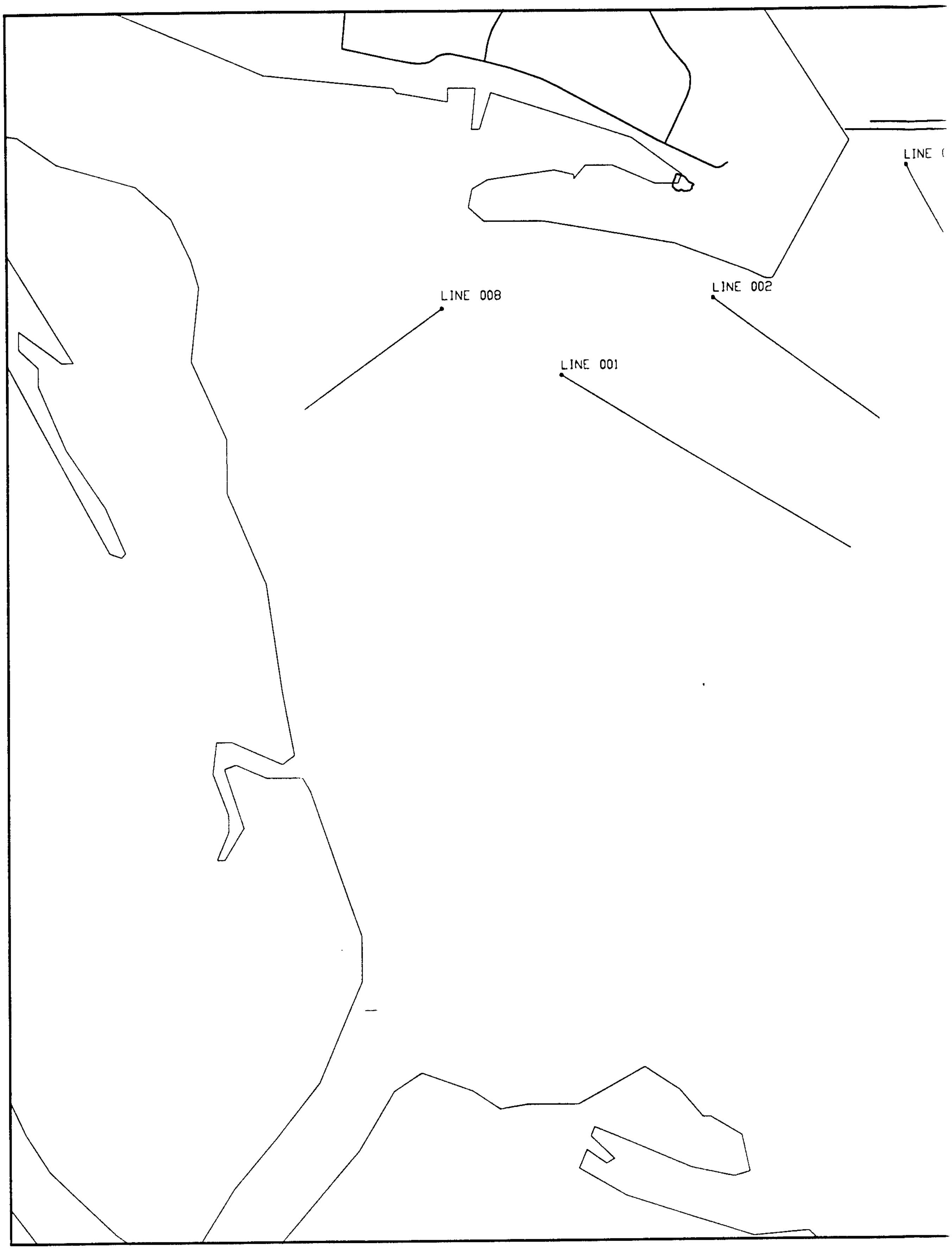
2

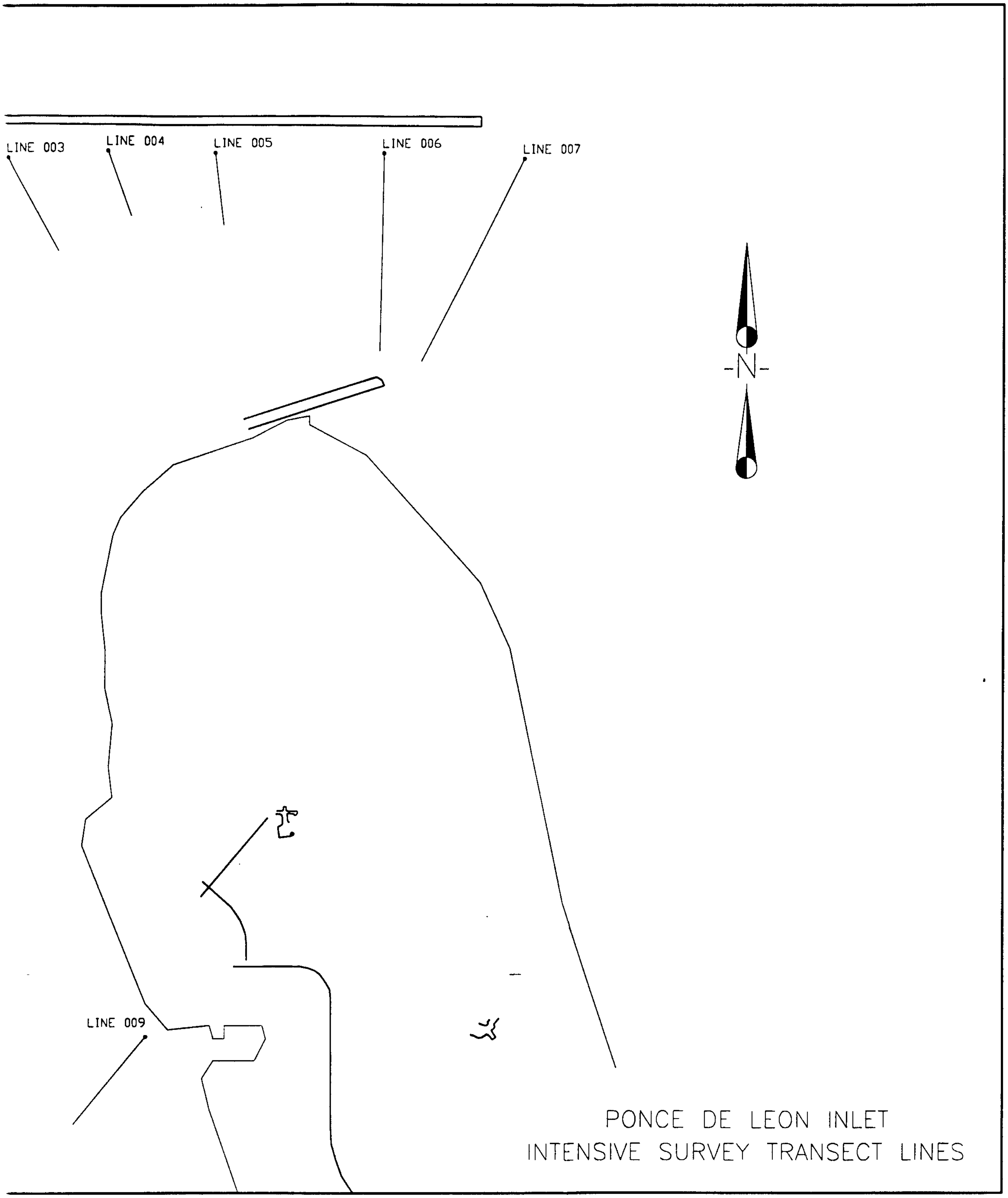
Plate A19




LINE 035
1326
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
29 AUGUST 1997
UNITS: CM/SEC

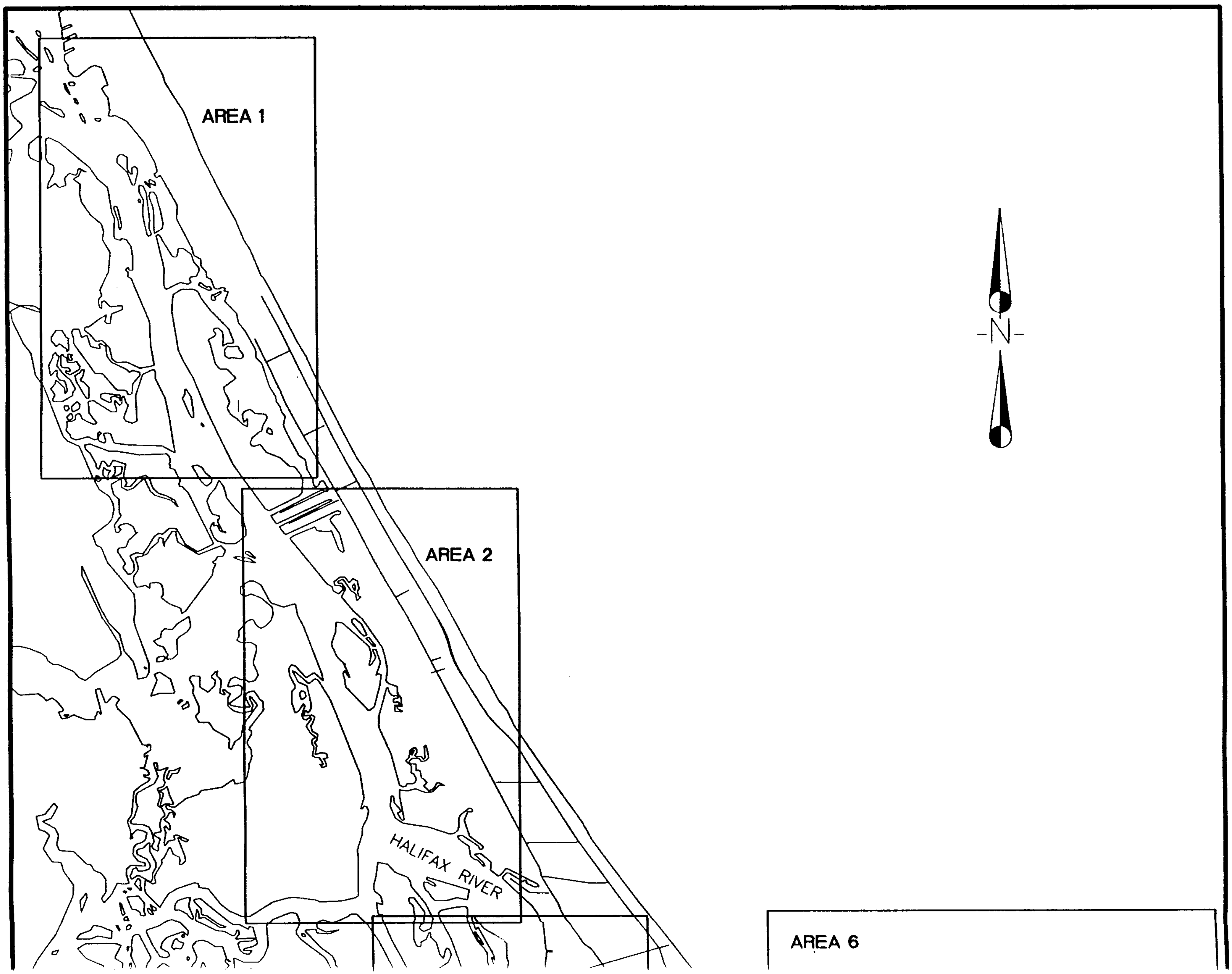
2


LINE 008
LINE 002
LINE 001

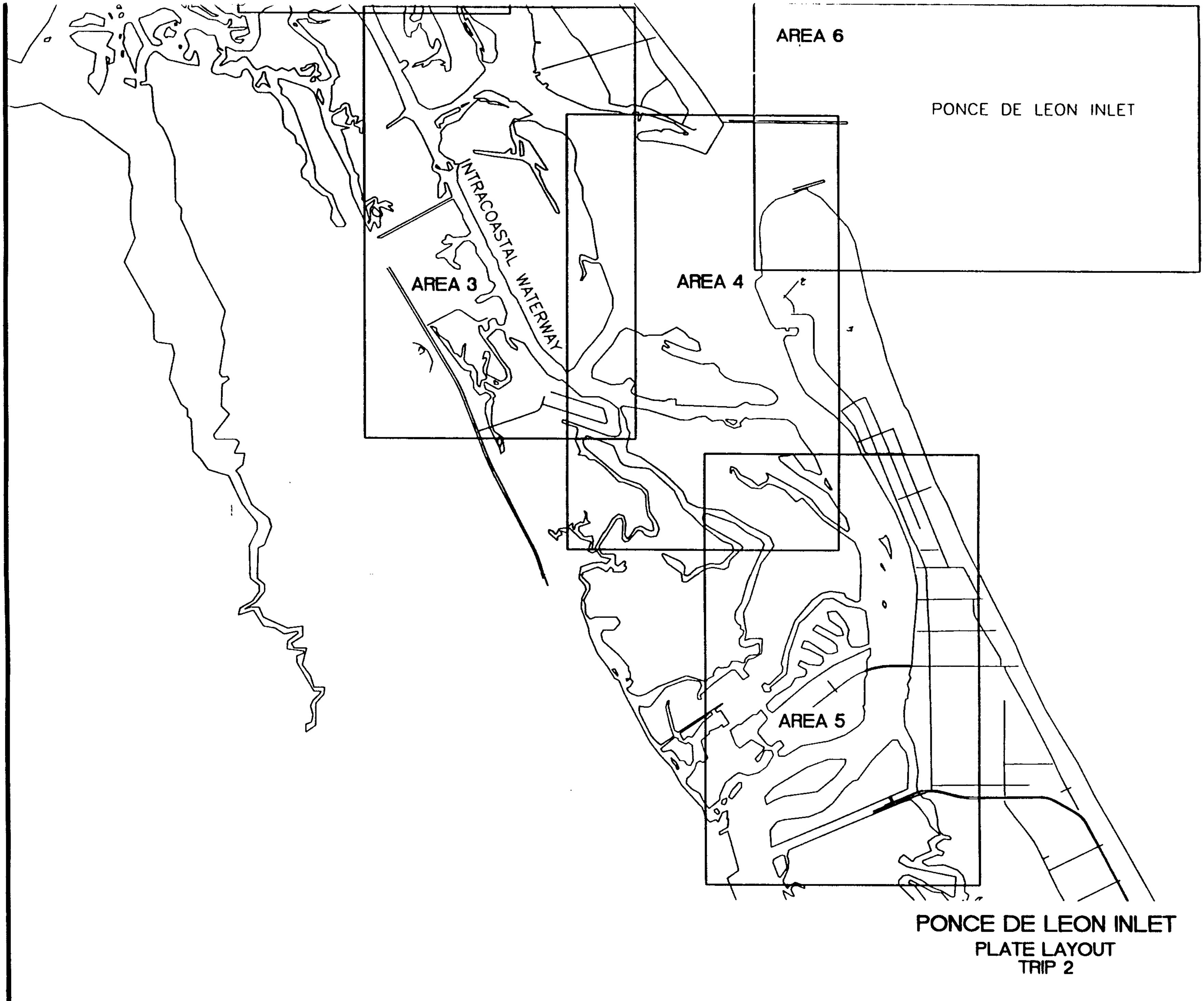


PONCE DE LEON INLET
INTENSIVE SURVEY TRANSECT LINES

2

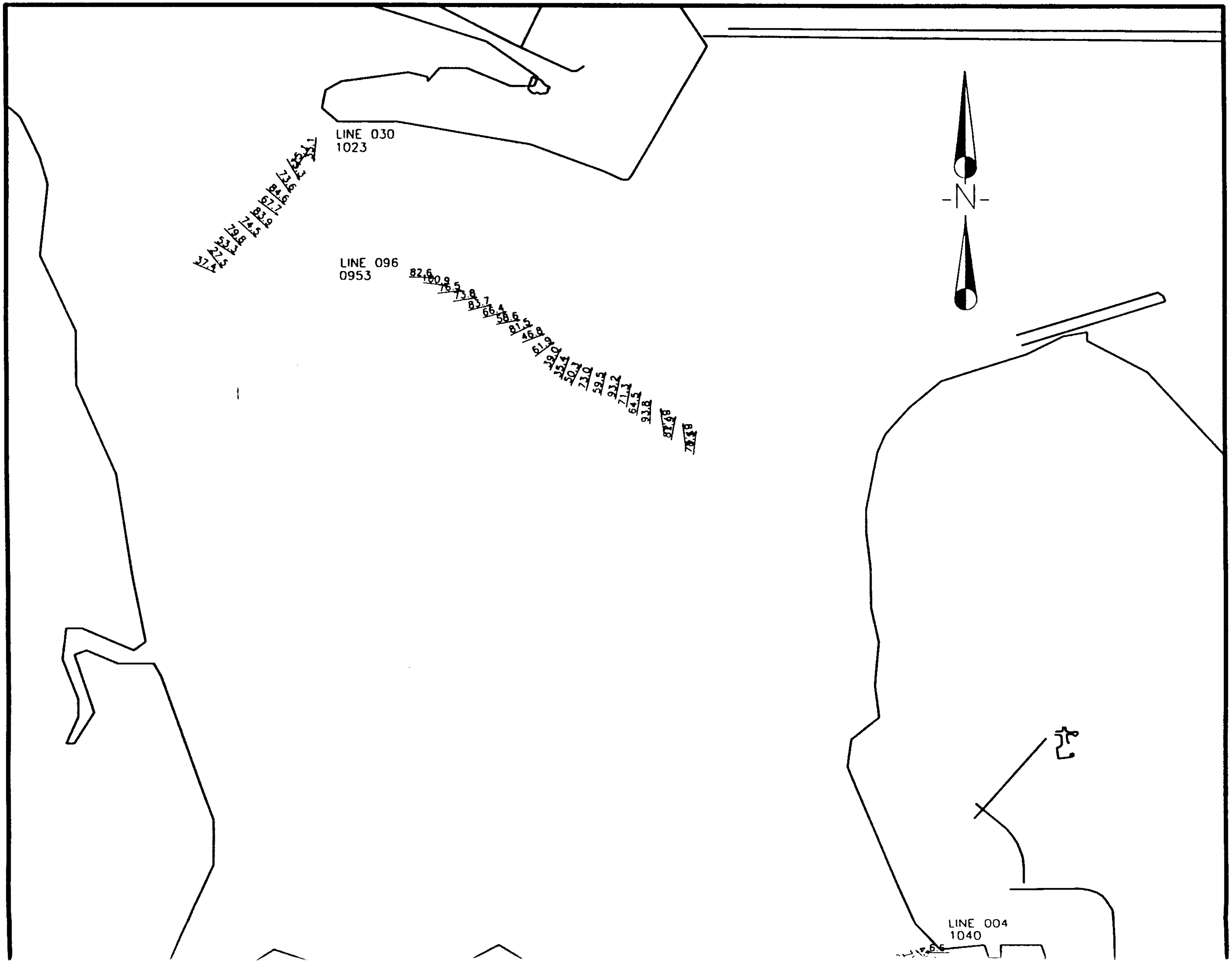


1



PONCE DE LEON INLET
PLATE LAYOUT
TRIP 2

2



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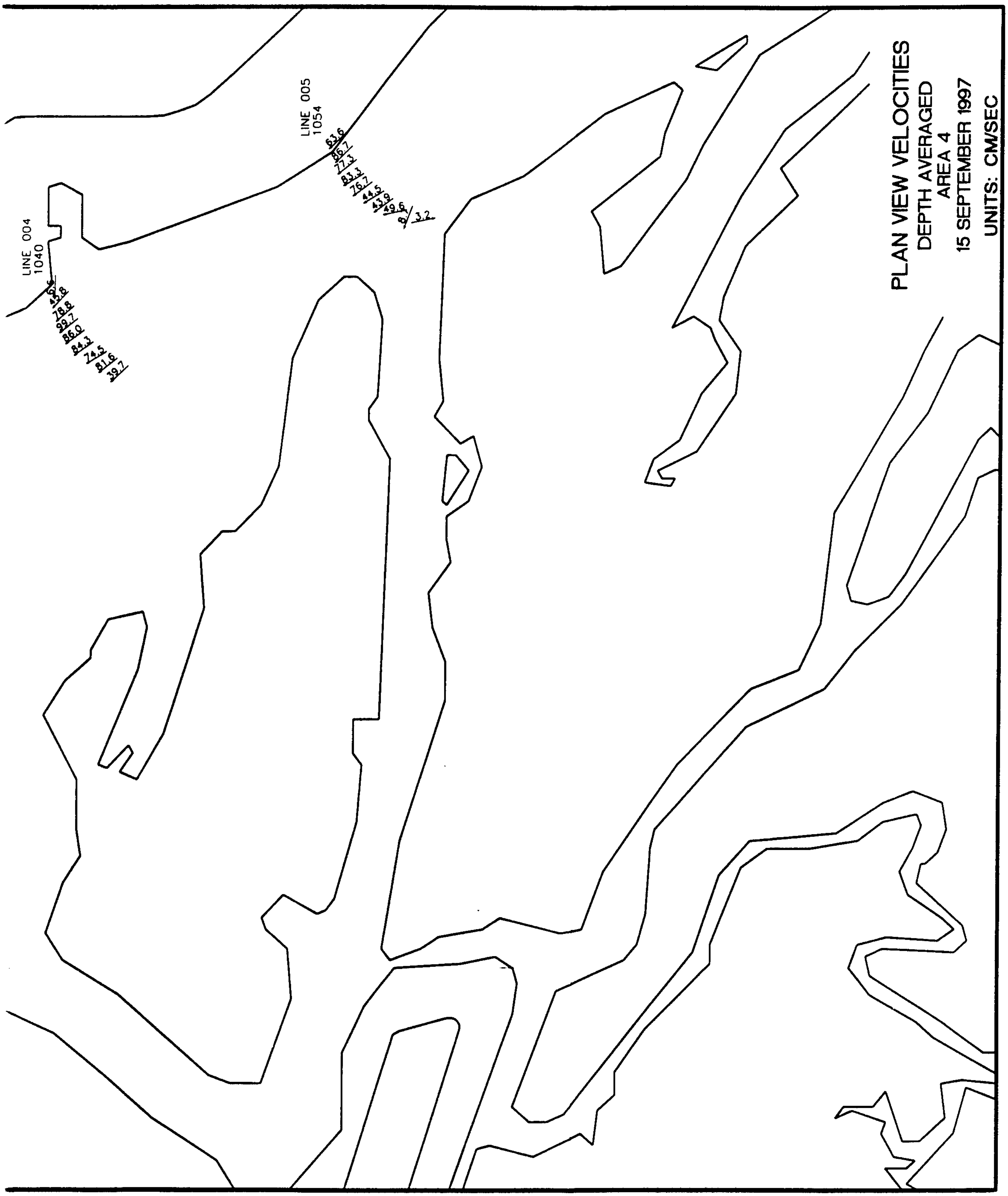
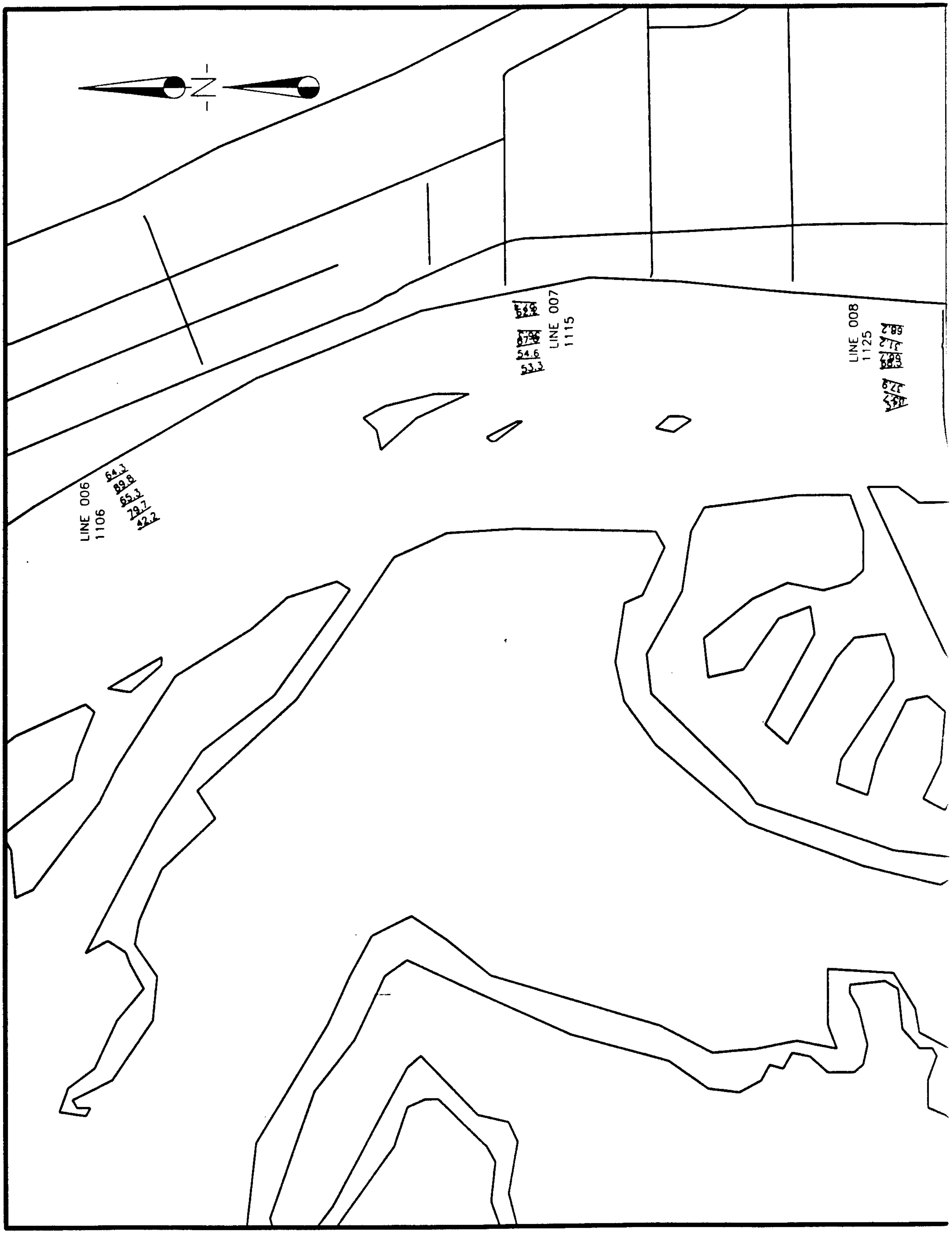
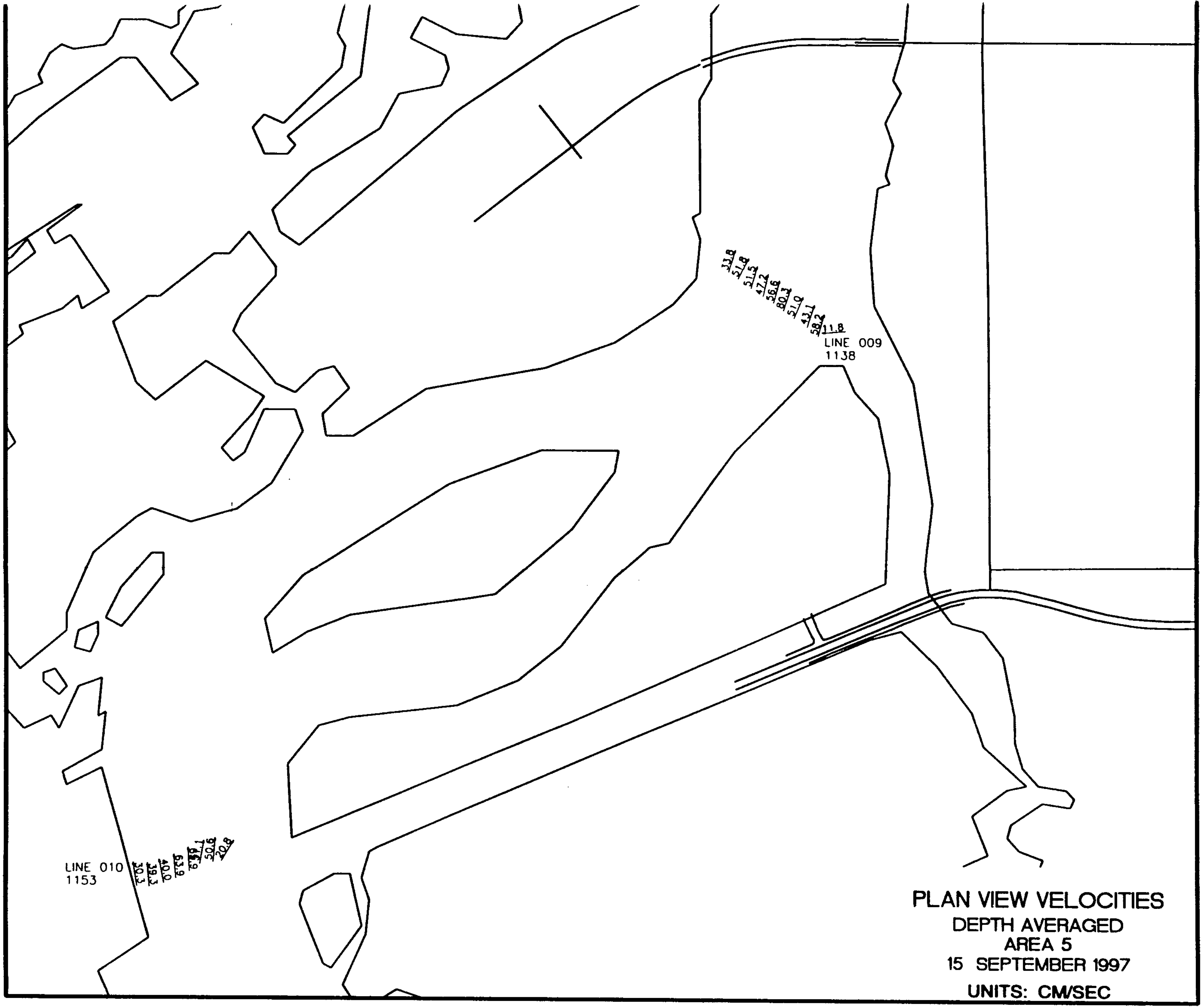
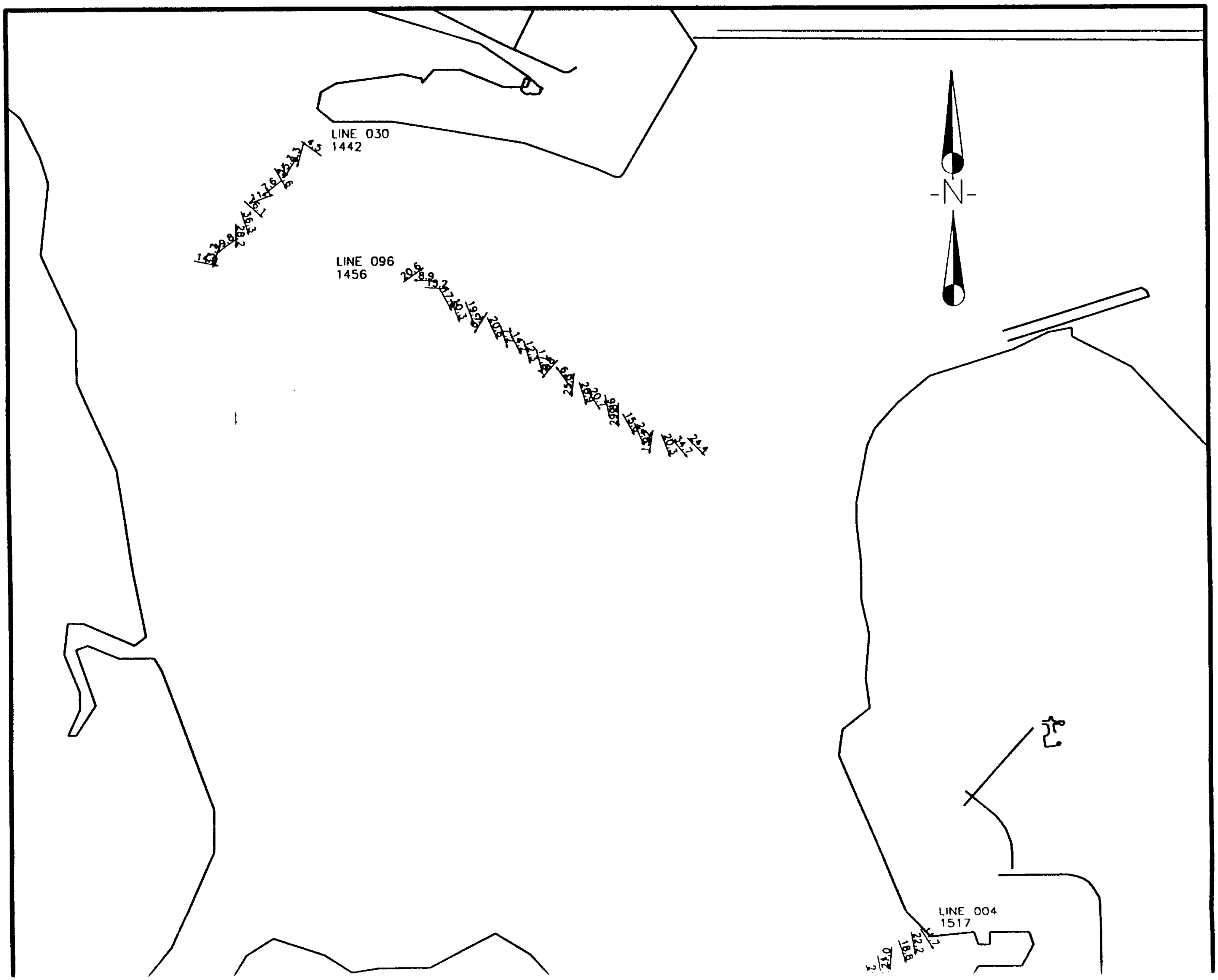

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
15 SEPTEMBER 1997
UNITS: CM/SEC
LINE 005
1054
63.6
86.7
77.3
83.3
76.7
44.5
43.9
49.6
8
3.2
LINE 004
1040
6
43.8
78.8
99.7
86.0
84.3
74.5
81.6
39.7


N
LINE 006
1106
64.3
89.8
65.3
79.7
42.2
LINE 007
1115
54.6
53.3
LINE 008
1125
68.2

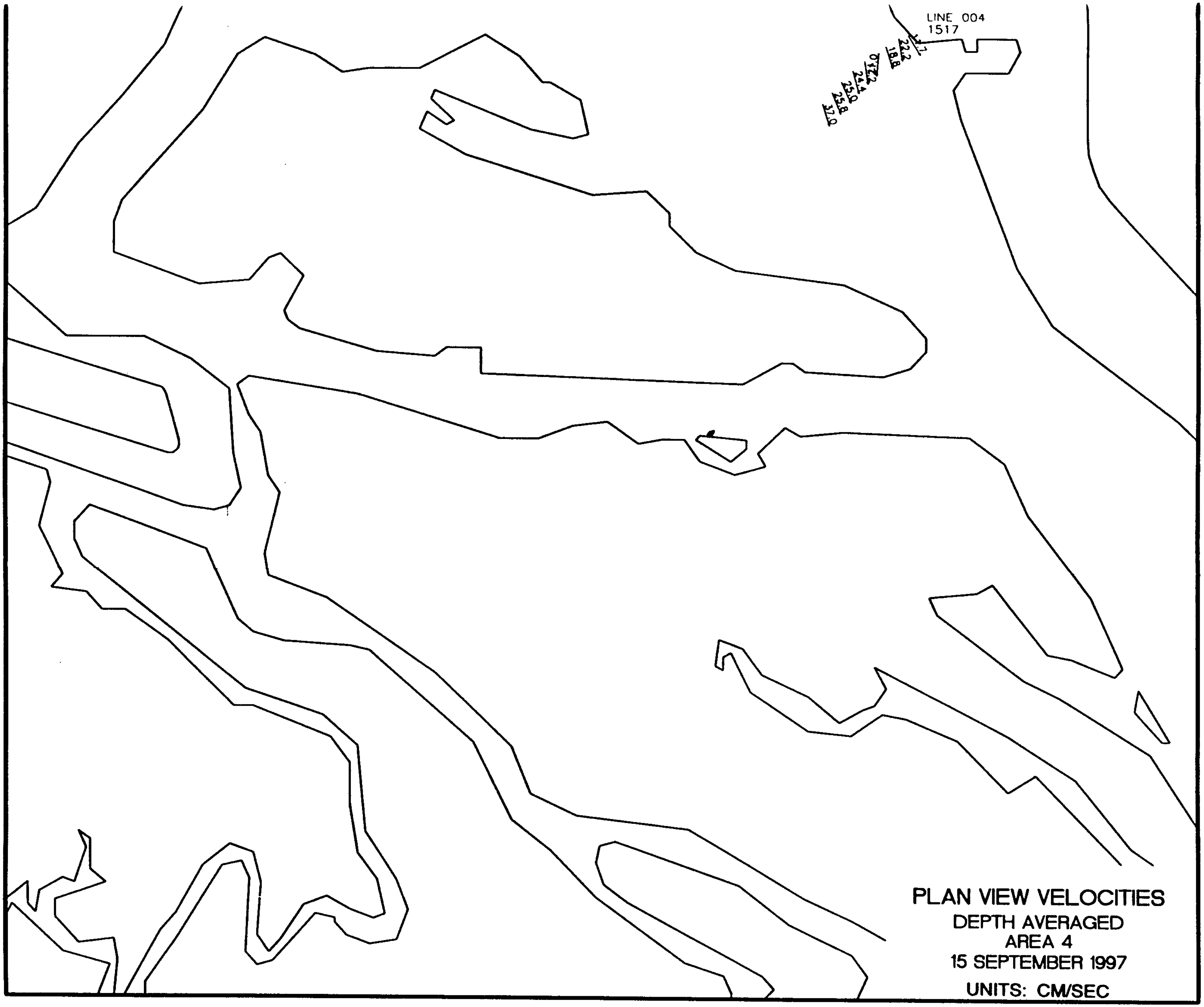


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 5
15 SEPTEMBER 1997
UNITS: CM/SEC

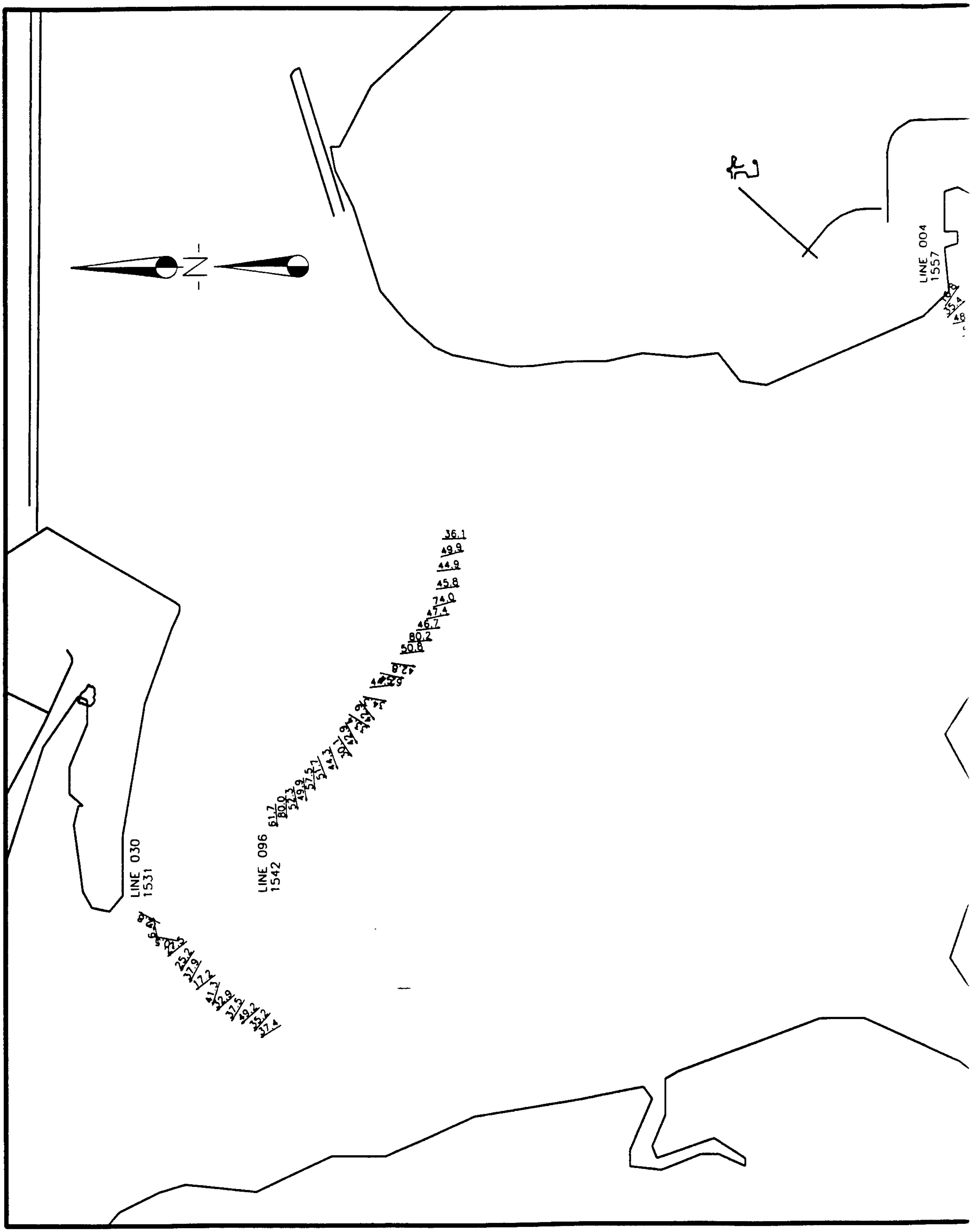
②



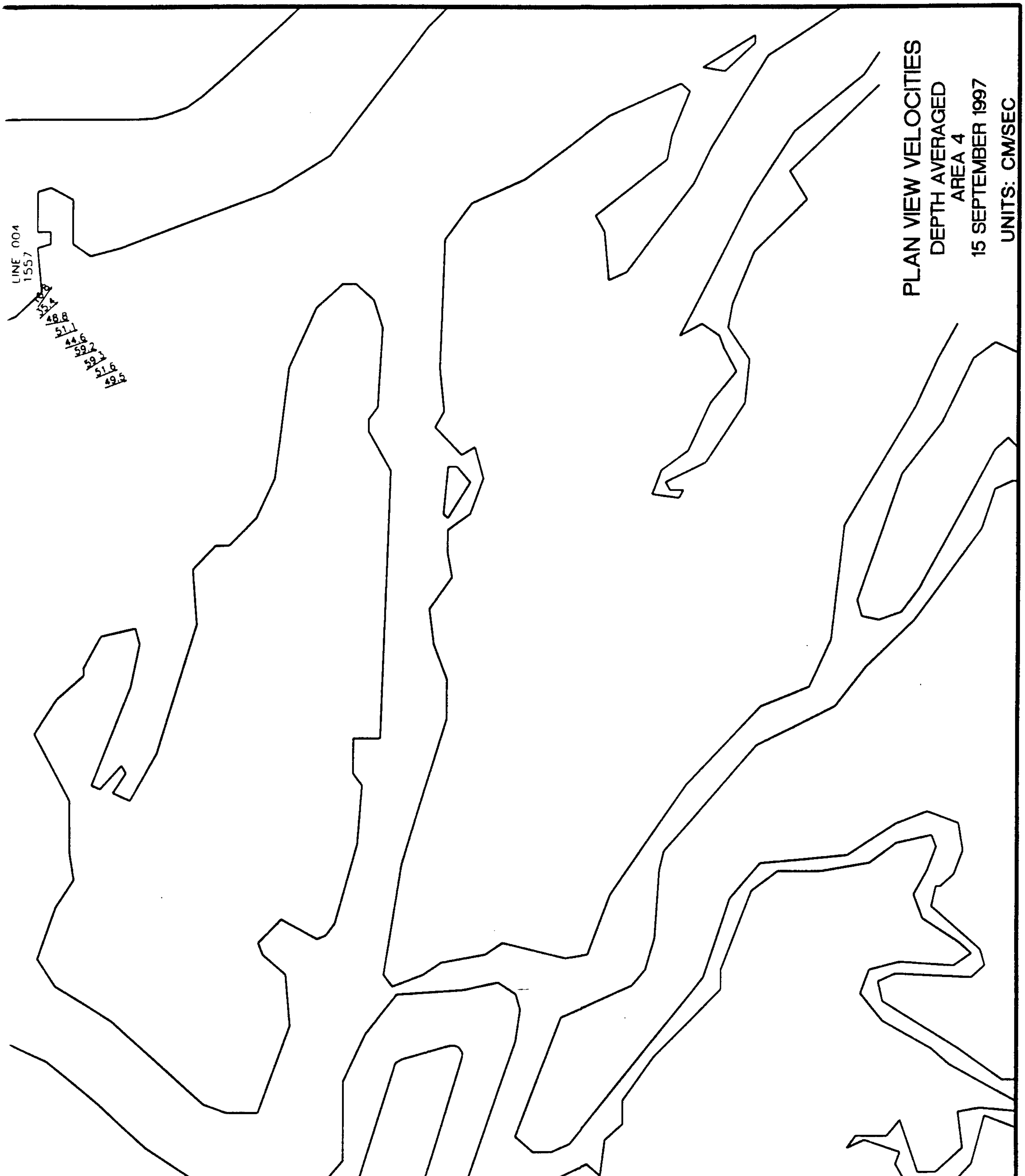
1


LINE 004
1517
22.2
18.8
24.4
25.0
25.8
37.0
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
15 SEPTEMBER 1997
UNITS: CM/SEC

2

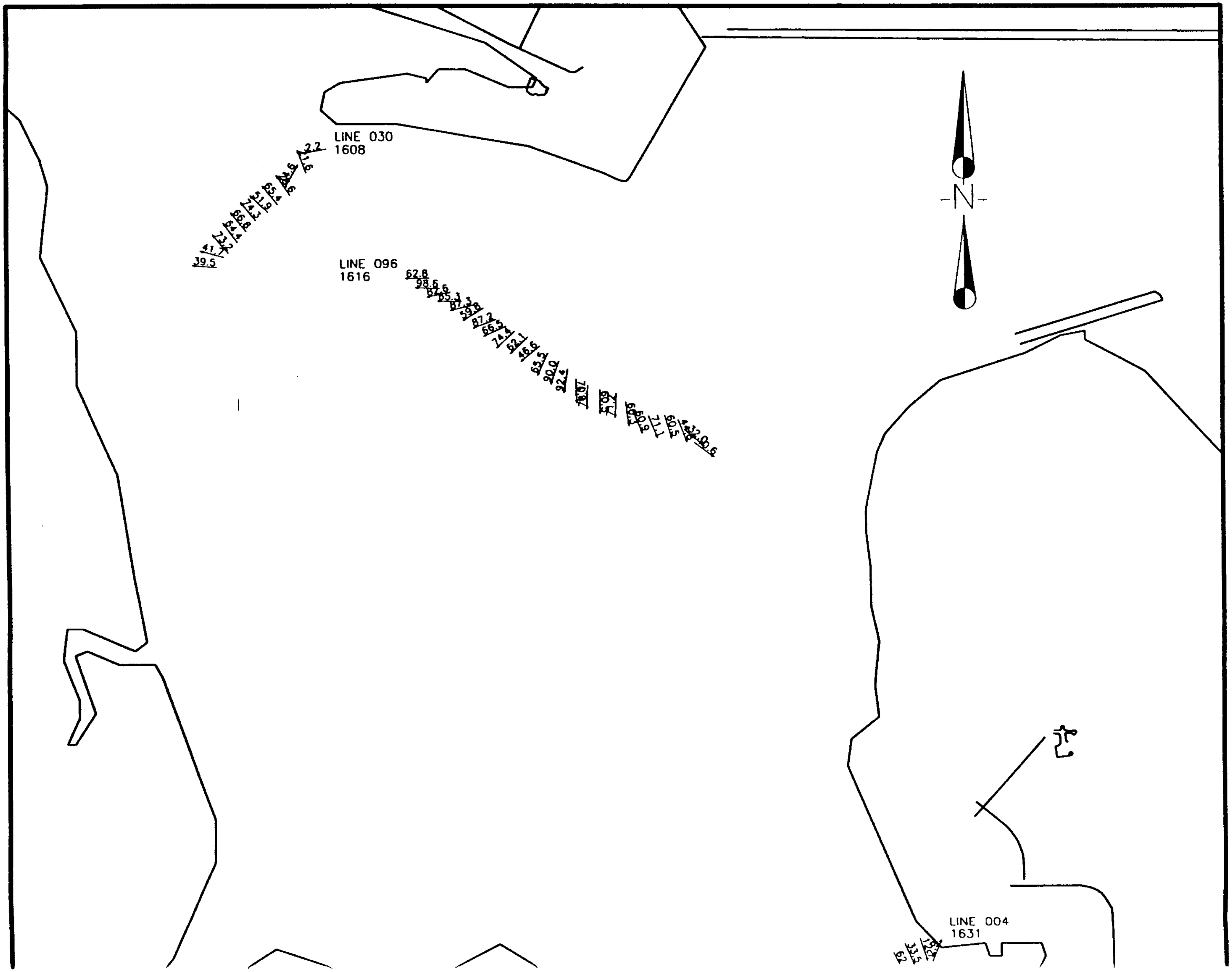

N
LINE 004
1557
LINE 096
1542
LINE 030
1531
36.1
49.9
44.9
45.8
74.0
47.4
46.7
80.2
50.8
61.7
80.0

1

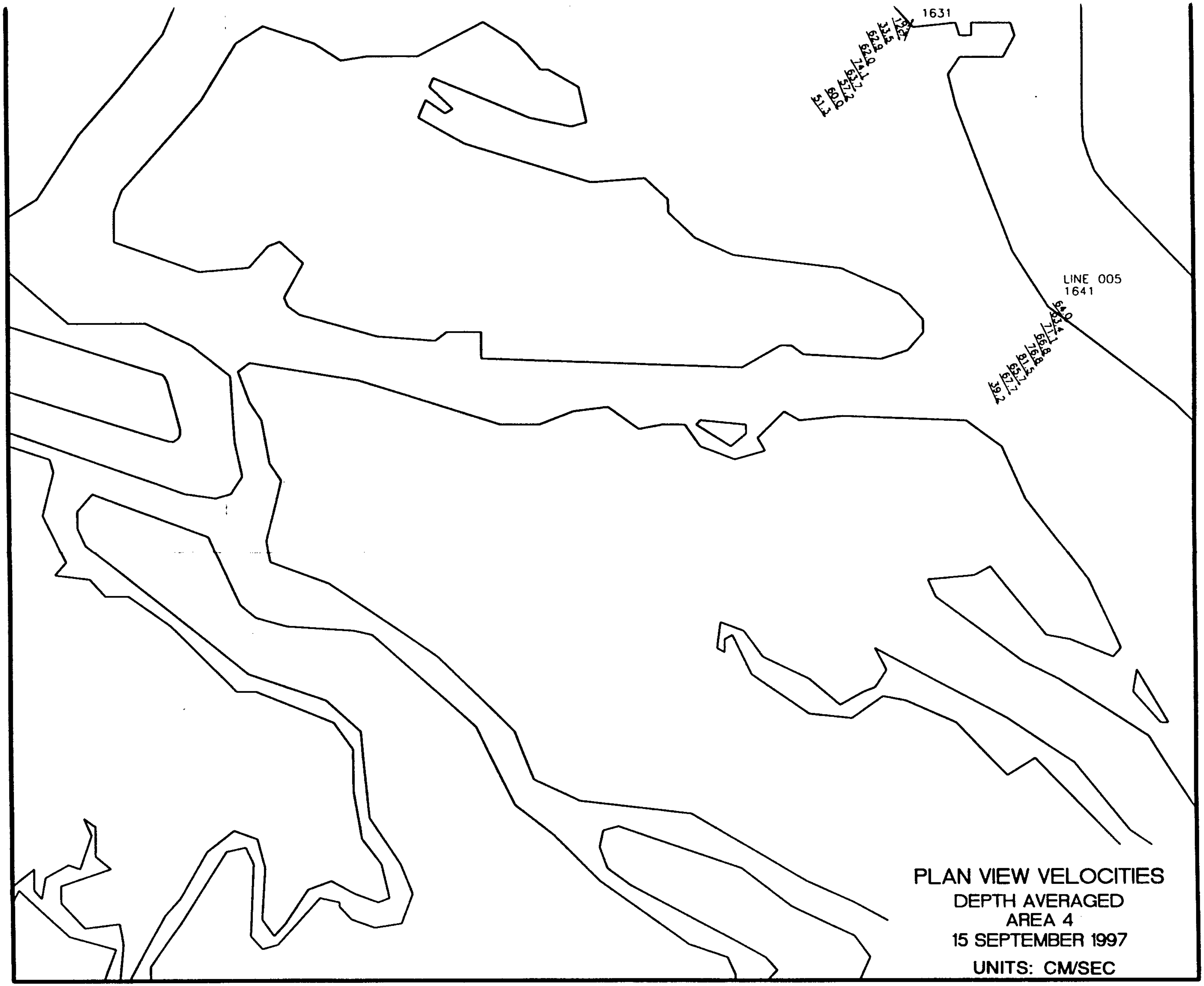

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
15 SEPTEMBER 1997
UNITS: CM/SEC
LINE 004
1557
35.4
48.8
51.1
44.6
59.2
59.3
51.6
49.5

2

Plate A26



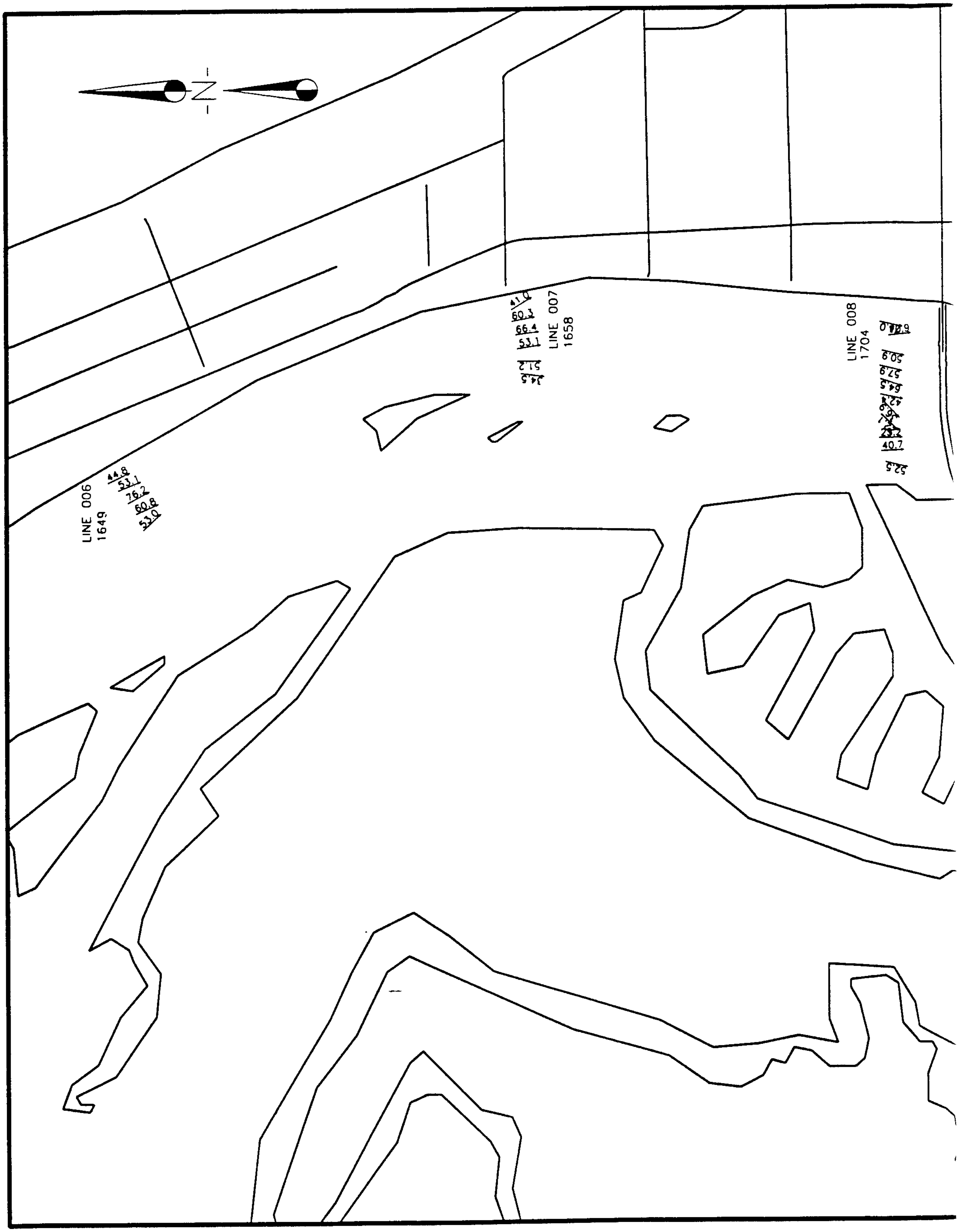
1



PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
15 SEPTEMBER 1997
UNITS: CM/SEC

2

Plate A27

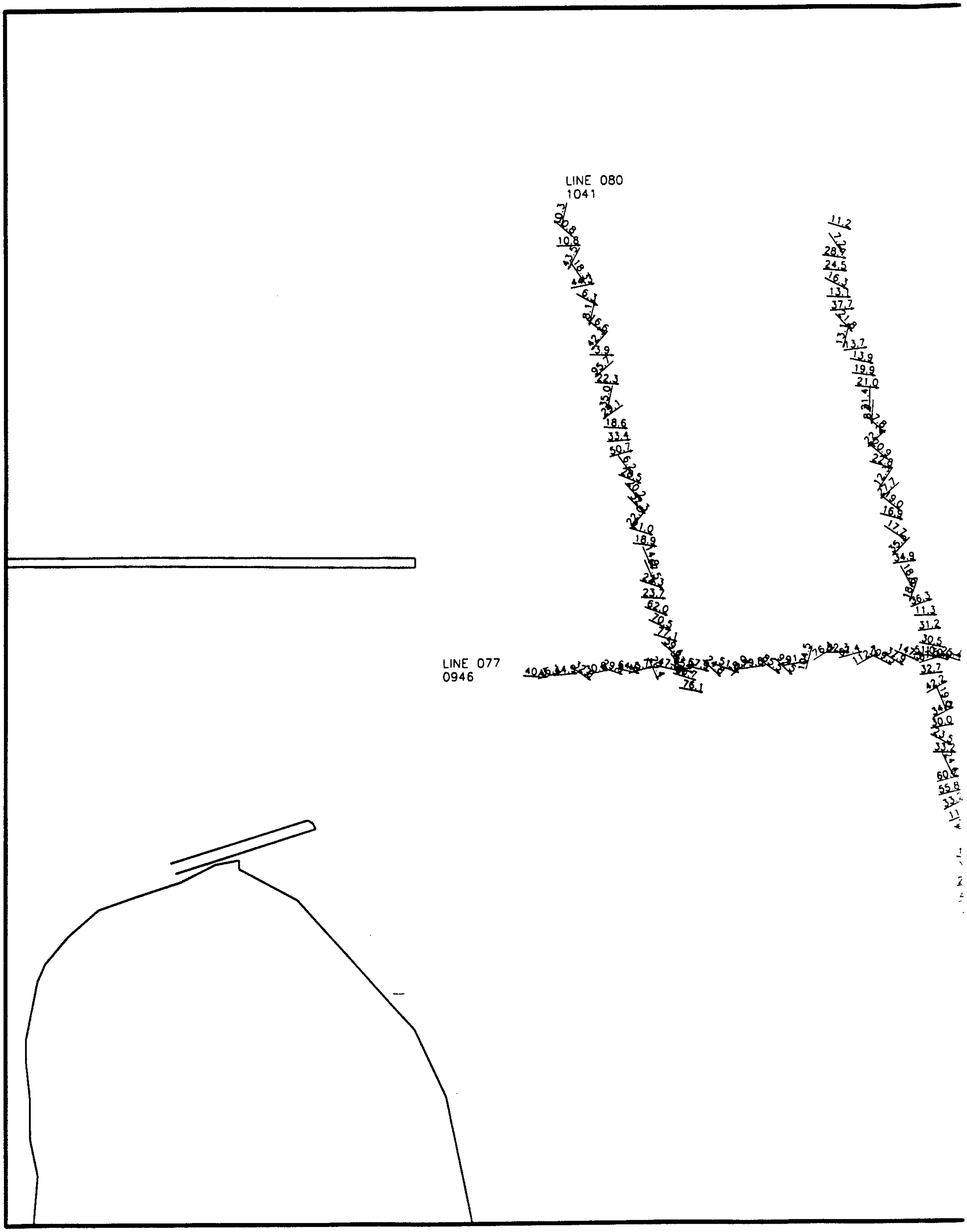


N
LINE 006
1649
44.8
53.1
76.2
60.8
53.0
LINE 007
1658
41.0
60.3
66.4
53.1
51.2
34.5
LINE 008
1704
50.9
57.9
64.5
40.7
52.5

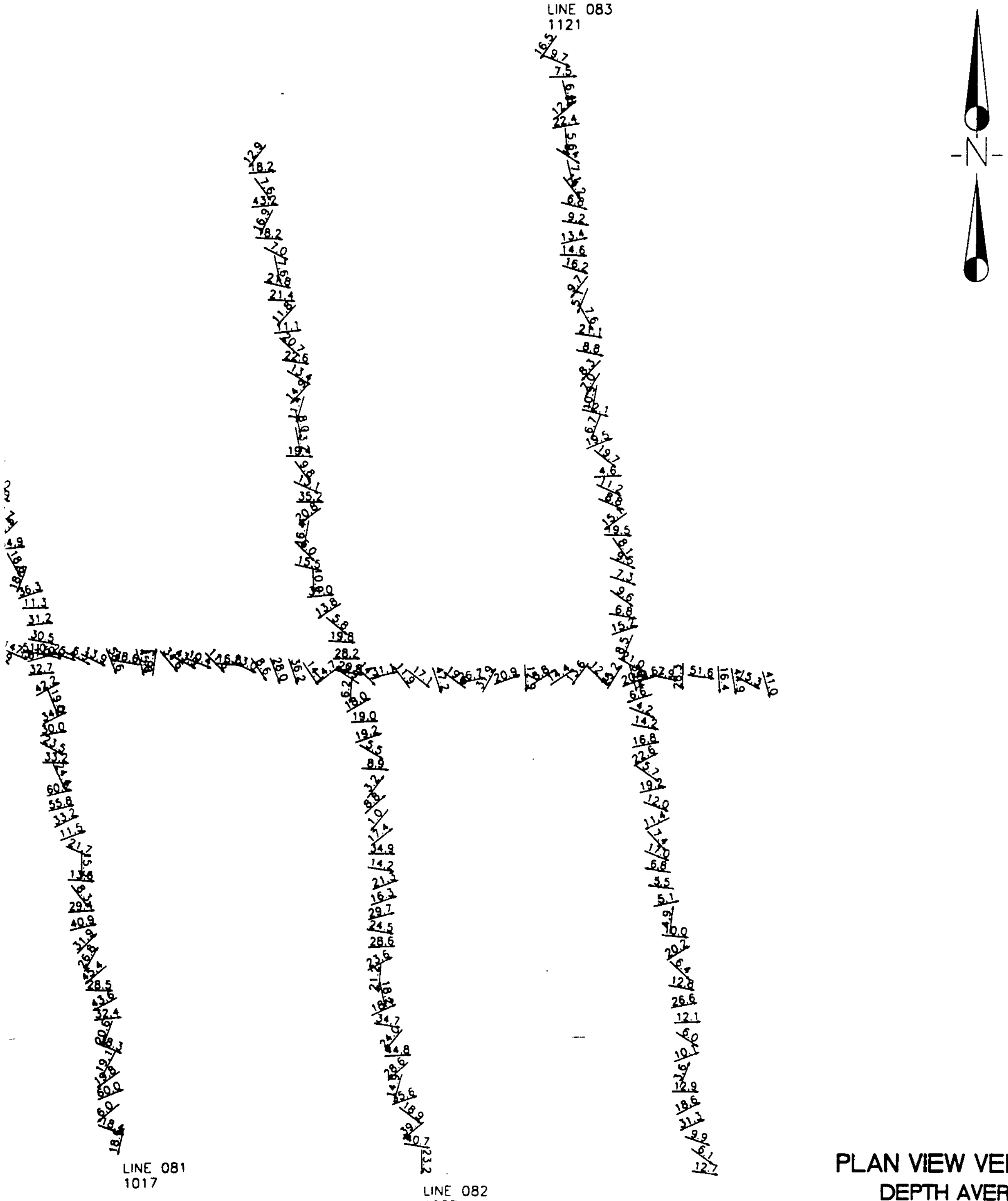
1

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 5
15 SEPTEMBER 1997
UNITS: CM/SEC

(2)

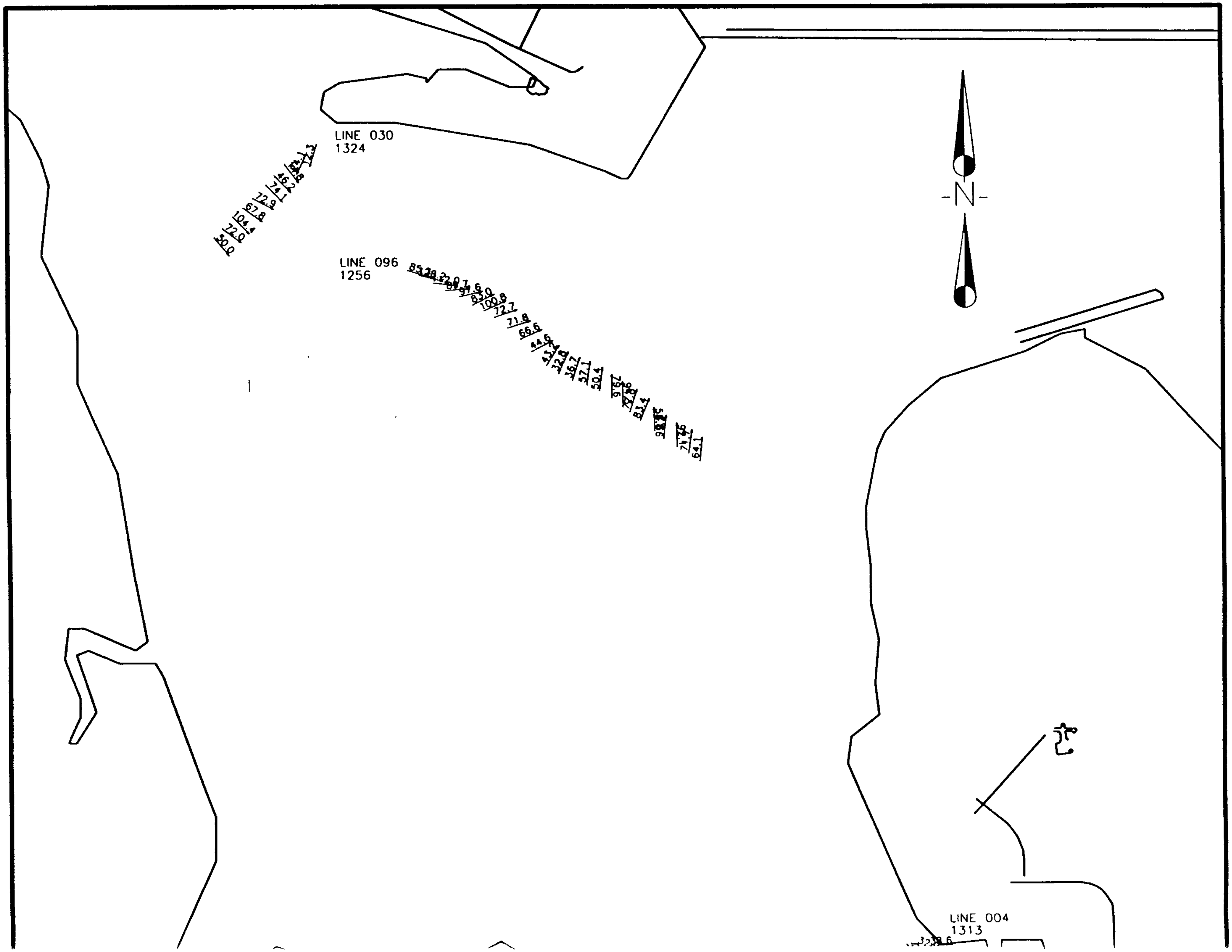


1

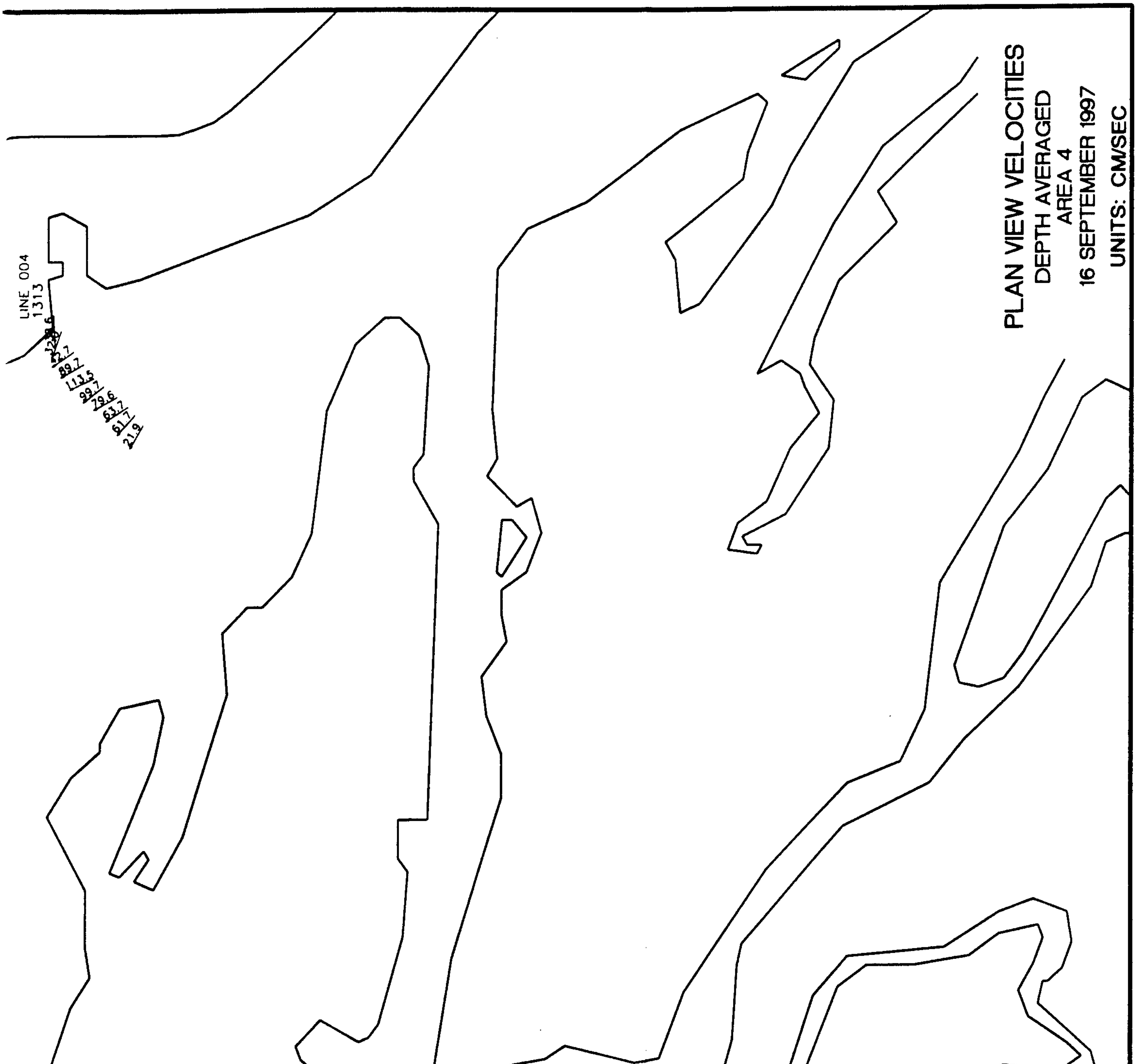


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 6
16 SEPTEMBER 1997
UNITS: CM/SEC

2

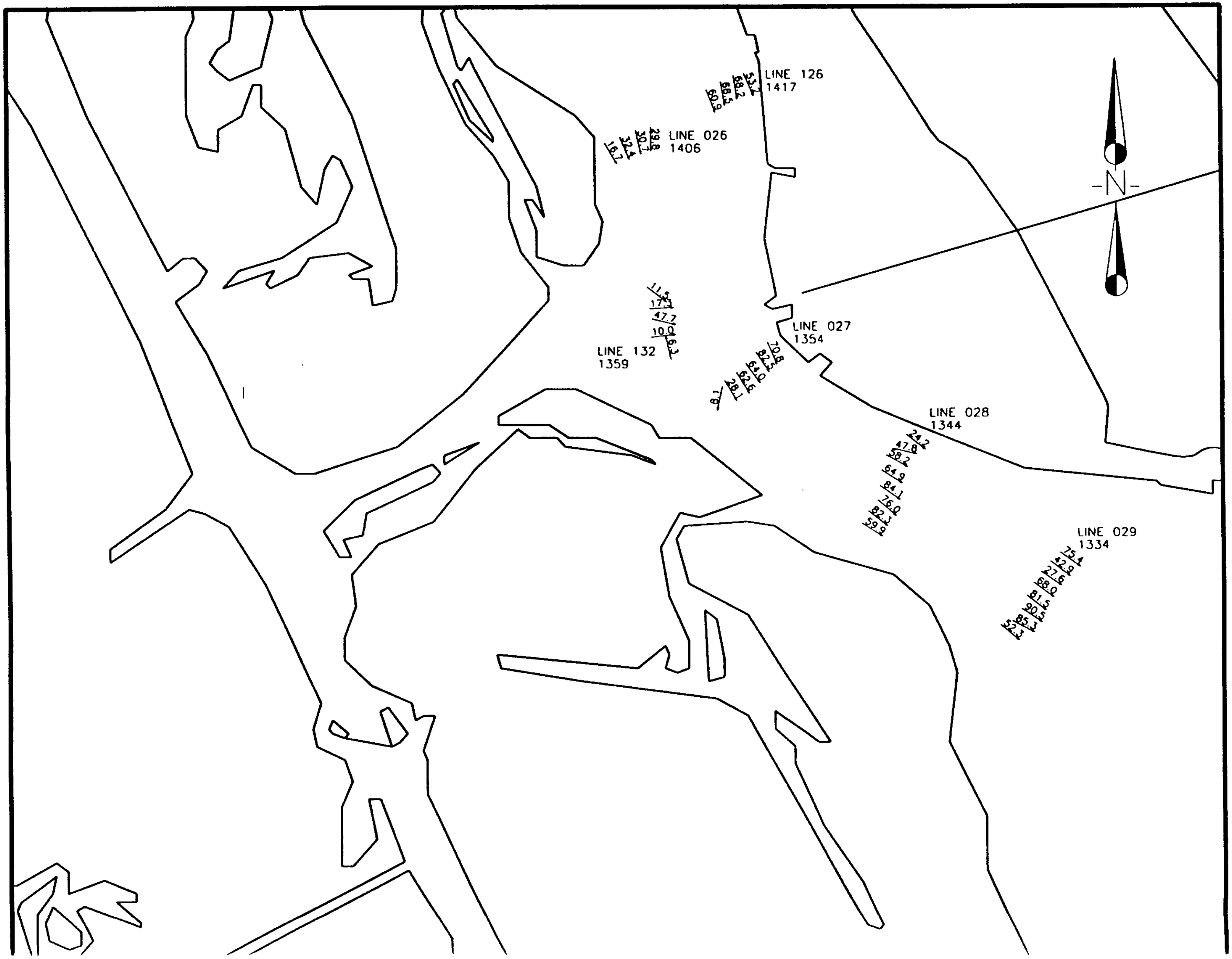

N
LINE 030
1324
46.2
74.1
72.9
67.8
104.4
72.0
50.0
LINE 096
1256
83.0
100.8
72.7
71.8
66.6
44.6
36.7
57.1
50.4
83.4
64.1
LINE 004
1313

1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
16 SEPTEMBER 1997
UNITS: CM/SEC
LINE 004
1313
89.7
113.5
99.7
79.6
63.7
61.7
21.9

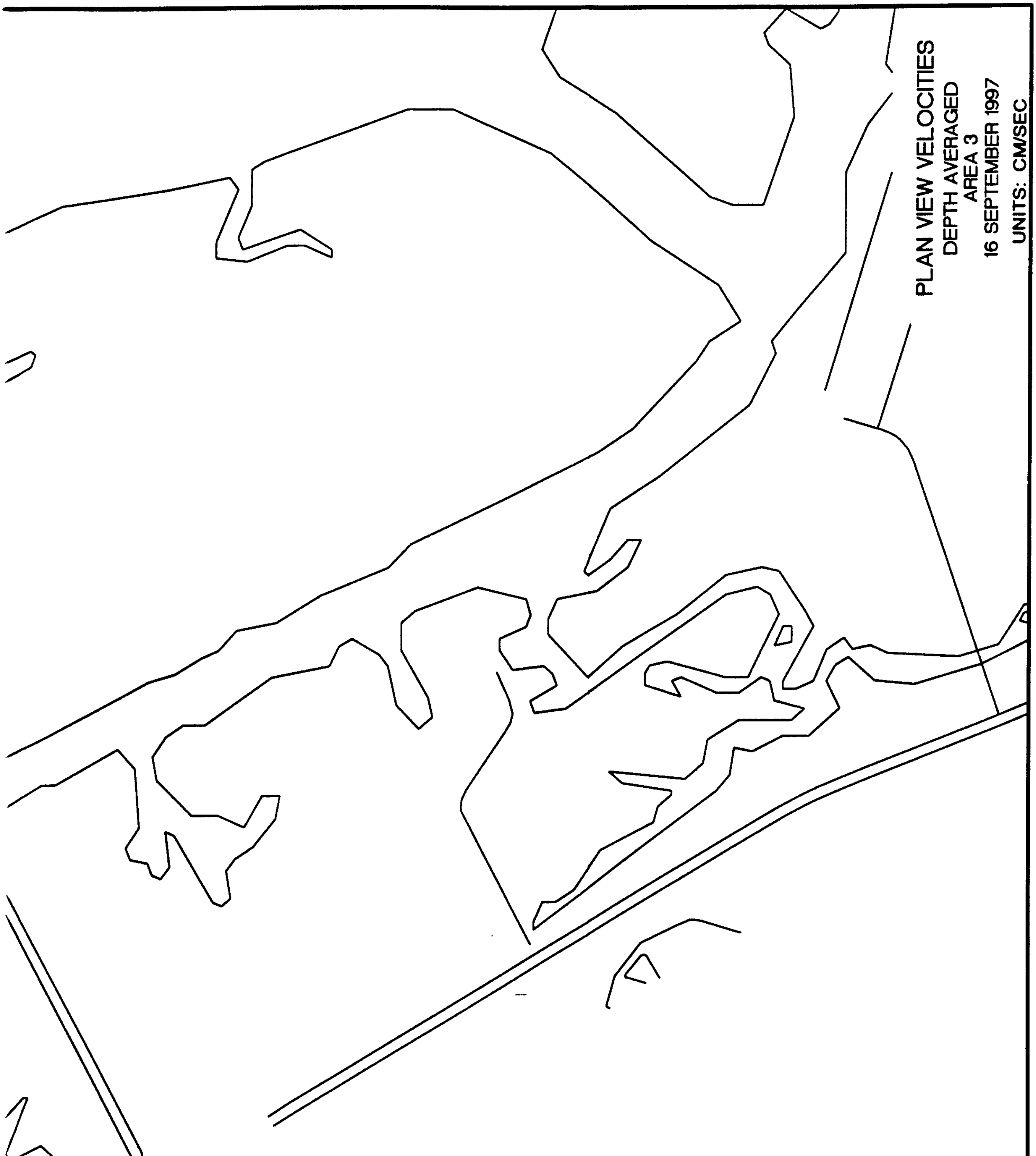
2

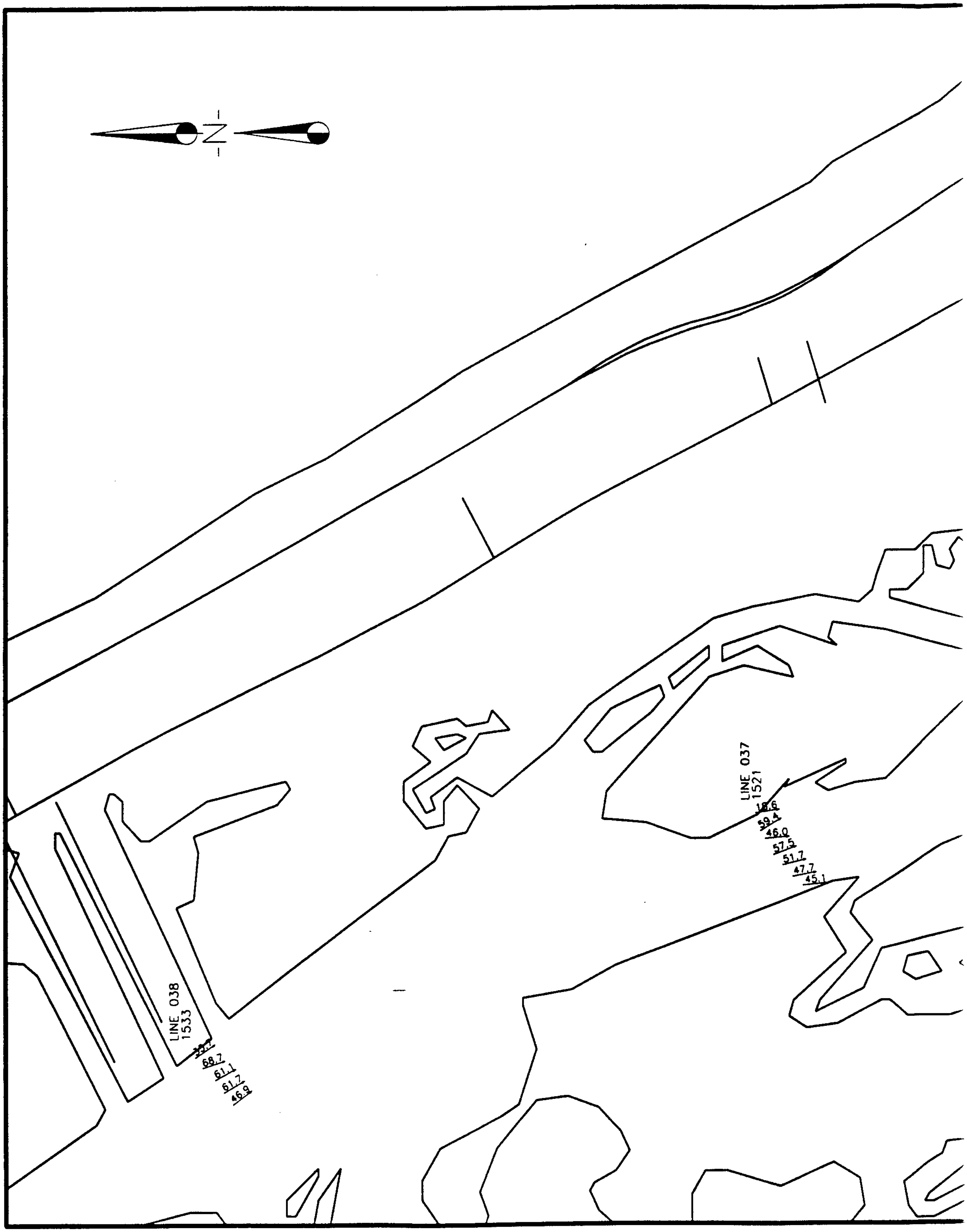
Plate A30

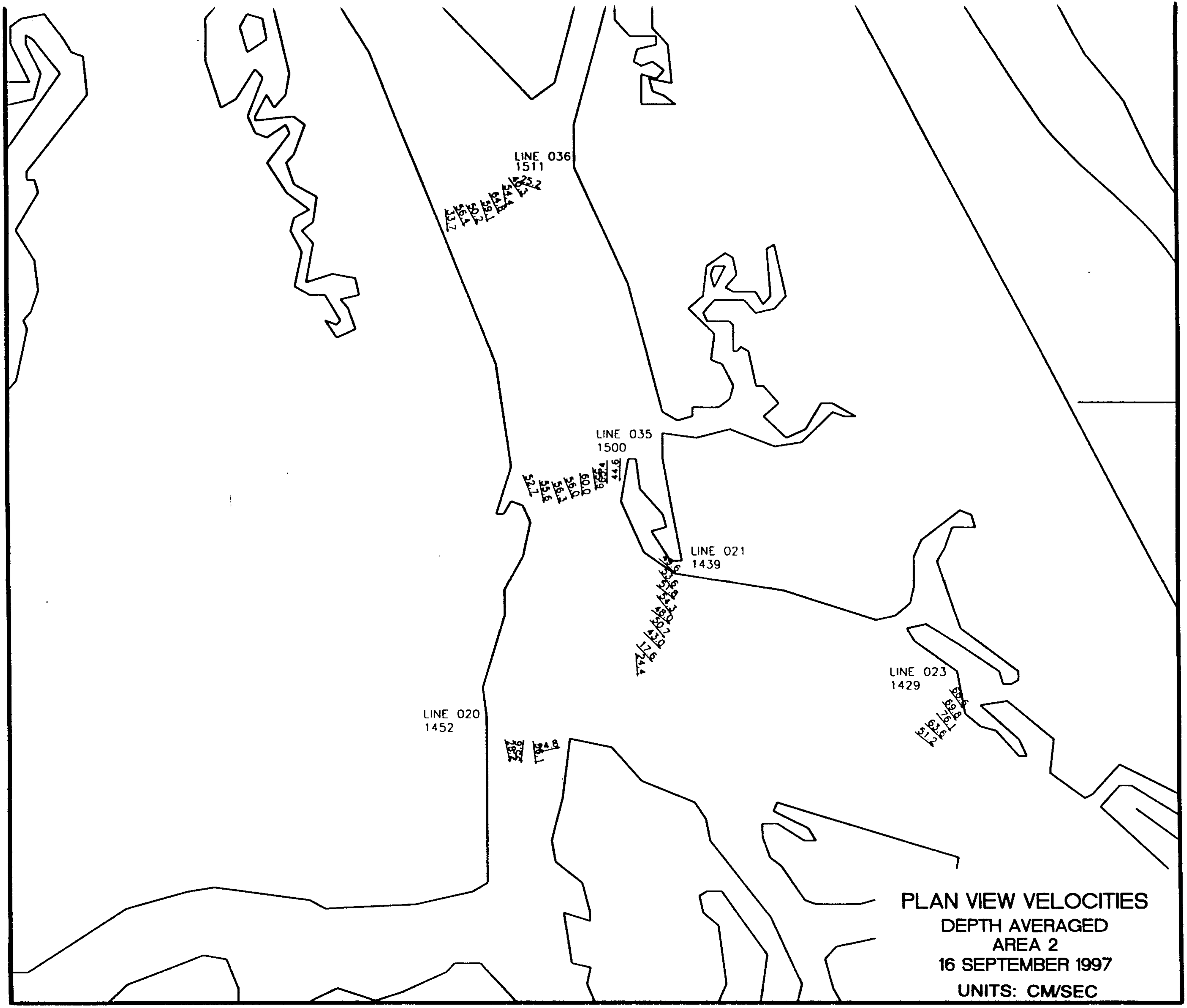


N
LINE 126
1417
53.2
68.2
68.5
60.9
LINE 026
1406
29.8
30.7
32.4
16.7
LINE 132
1359
11.5
17.3
47.7
10.0
6.3
LINE 027
1354
70.8
82.5
64.0
62.6
28.1
8.1
LINE 028
1344
24.2
47.8
58.2
64.9
84.1
76.0
82.3
59.9
LINE 029
1334
75.4
42.9
27.6
68.0
81.5
90.5
85.3
52.3

1

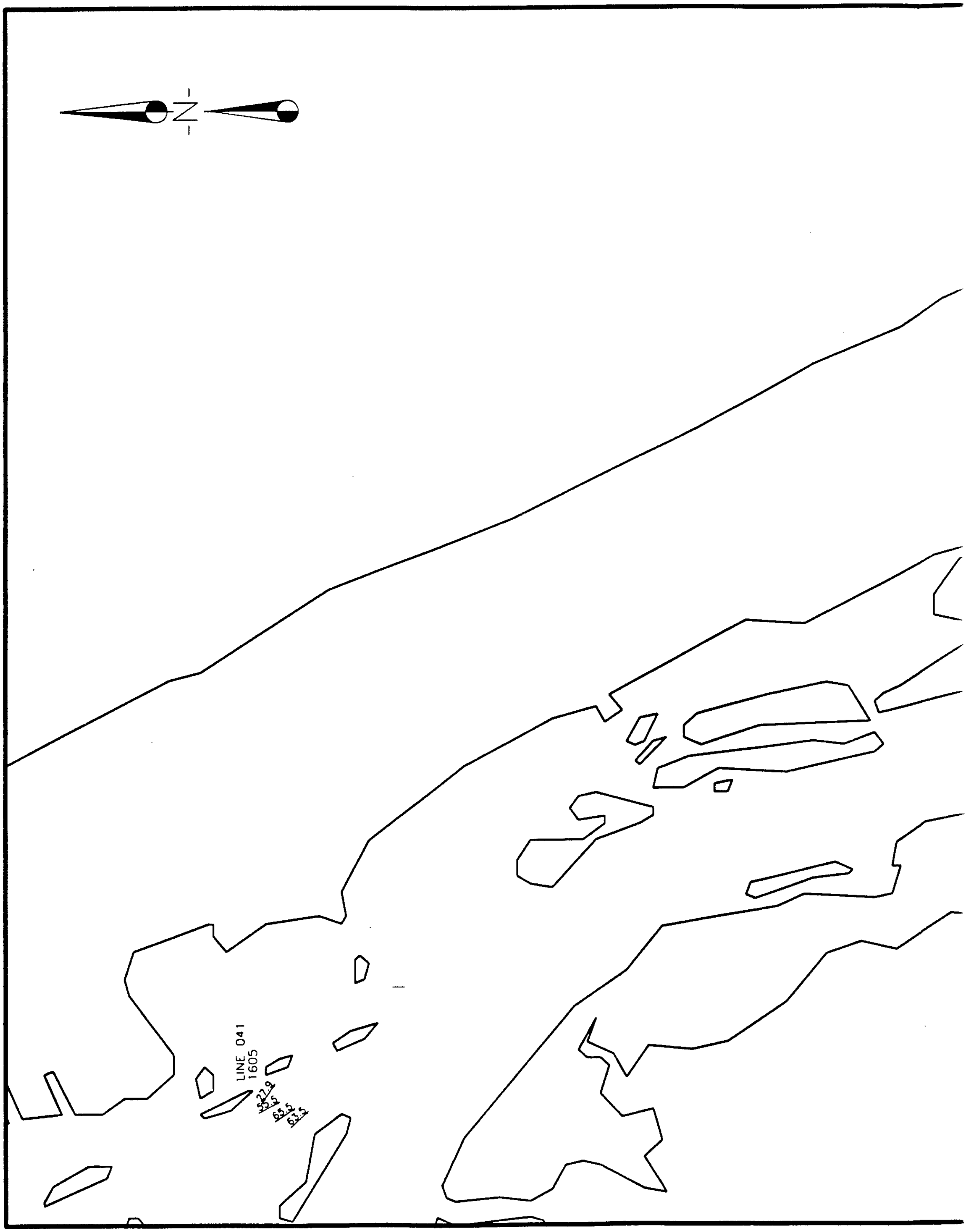

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 3
16 SEPTEMBER 1997
UNITS: CM/SEC

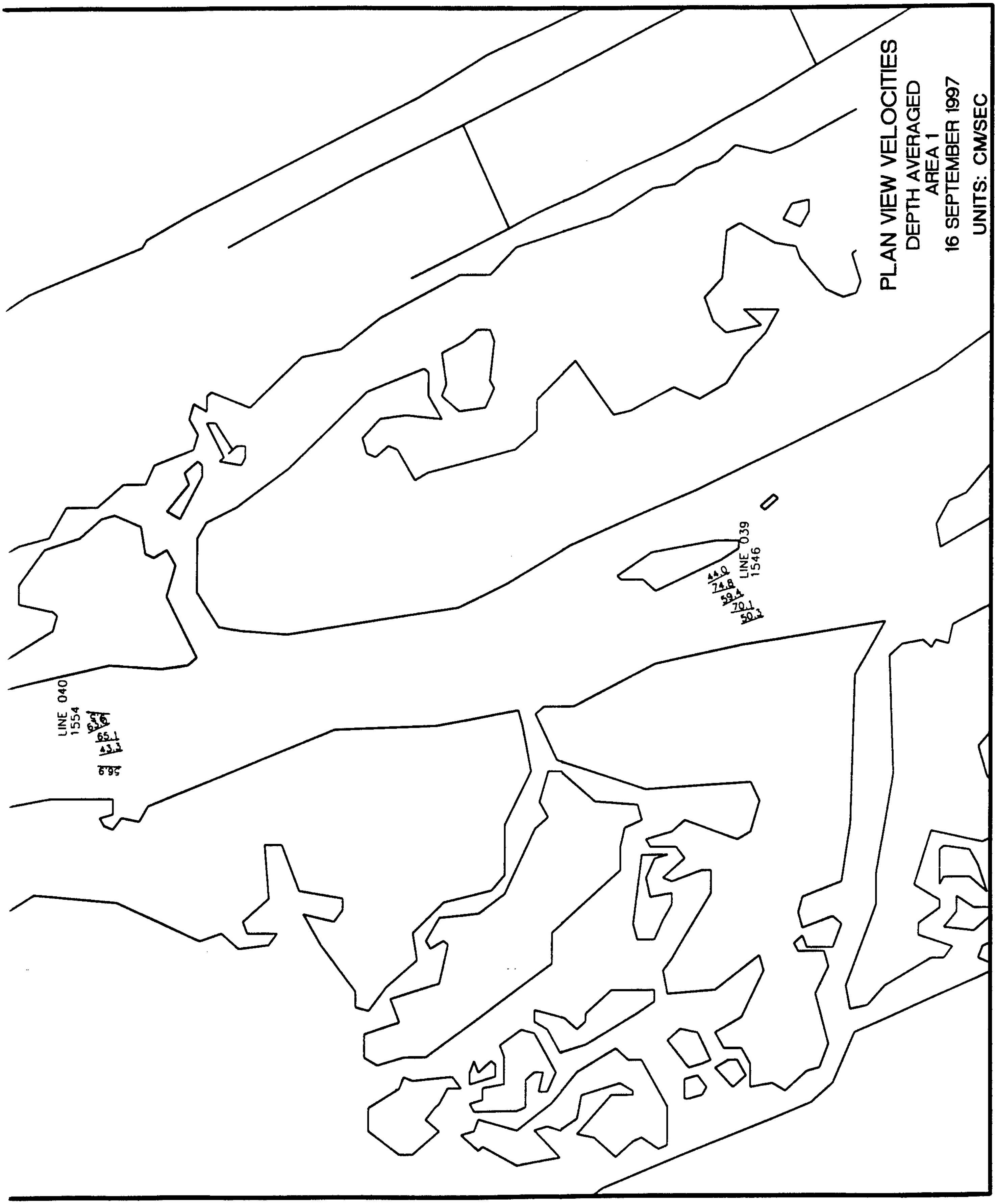

N
LINE 038
1533
68.7
61.1
61.7
46.9
LINE 037
1521
18.6
59.4
46.0
57.5
51.7
47.7
45.1


LINE 036
1511
25.2
54.4
59.1
50.2
56.4
33.7
LINE 035
1500
44.6
60.0
56.0
56.3
55.6
52.7
LINE 021
1439
48.0
50.7
43.0
17.6
24.4
LINE 023
1429
69.8
76.1
63.6
51.2
LINE 020
1452
24.8
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
16 SEPTEMBER 1997
UNITS: CM/SEC

2

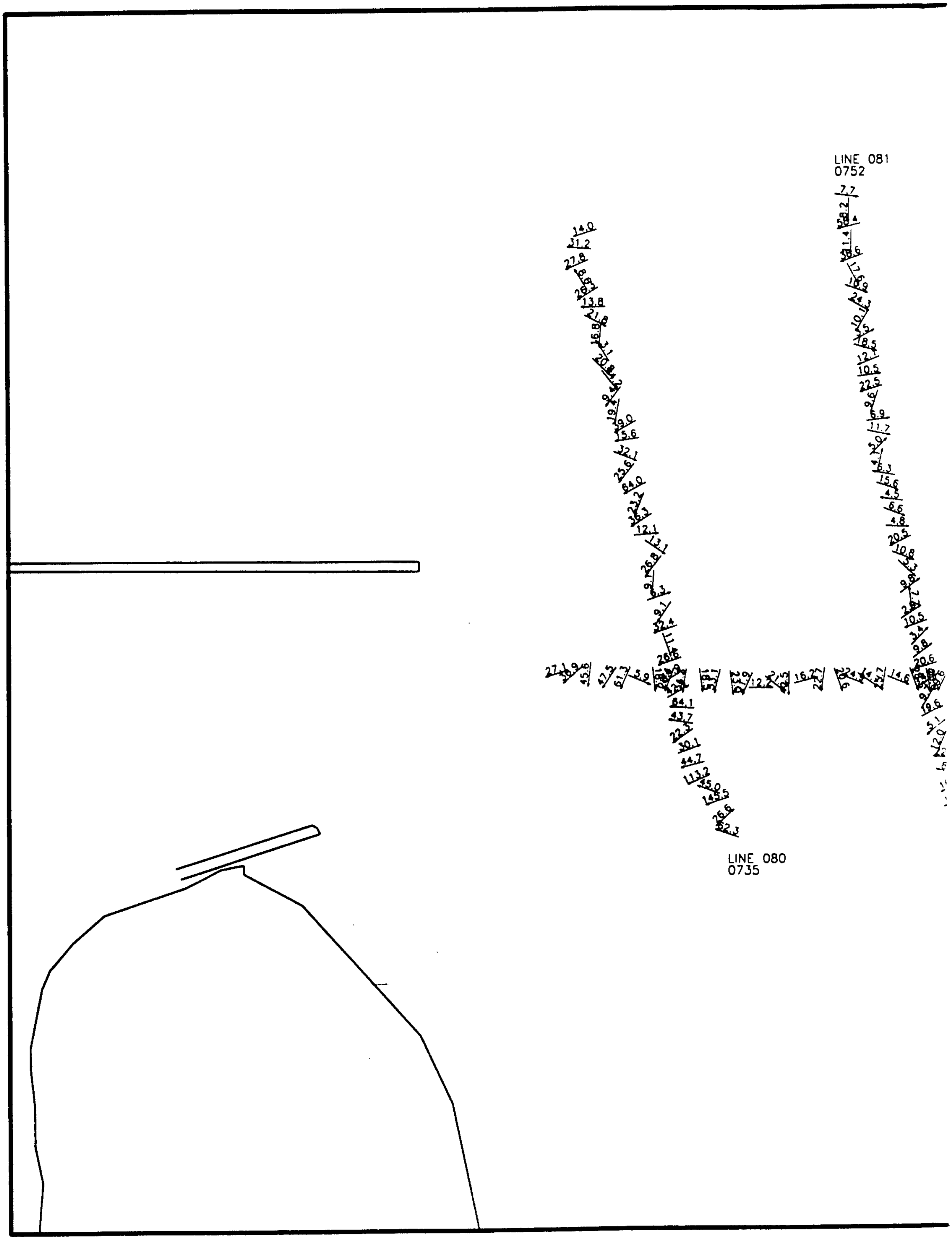
Plate A32

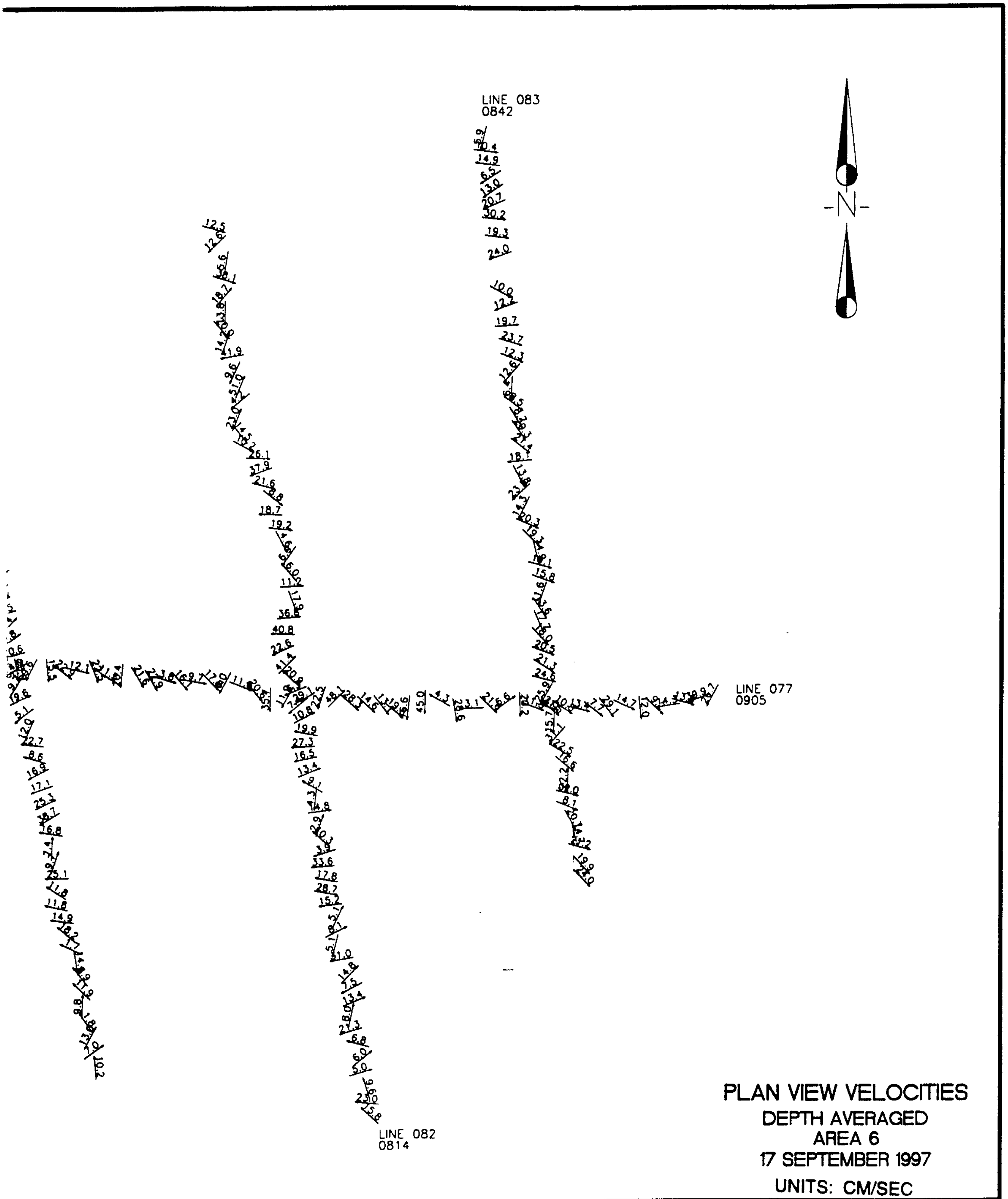

N
LINE 041
1605
27.9
63.5
63.5


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 1
16 SEPTEMBER 1997
UNITS: CM/SEC
LINE 039
1546
44.0
74.8
59.4
70.1
50.3
LINE 040
1554
65.1
43.3
56.9

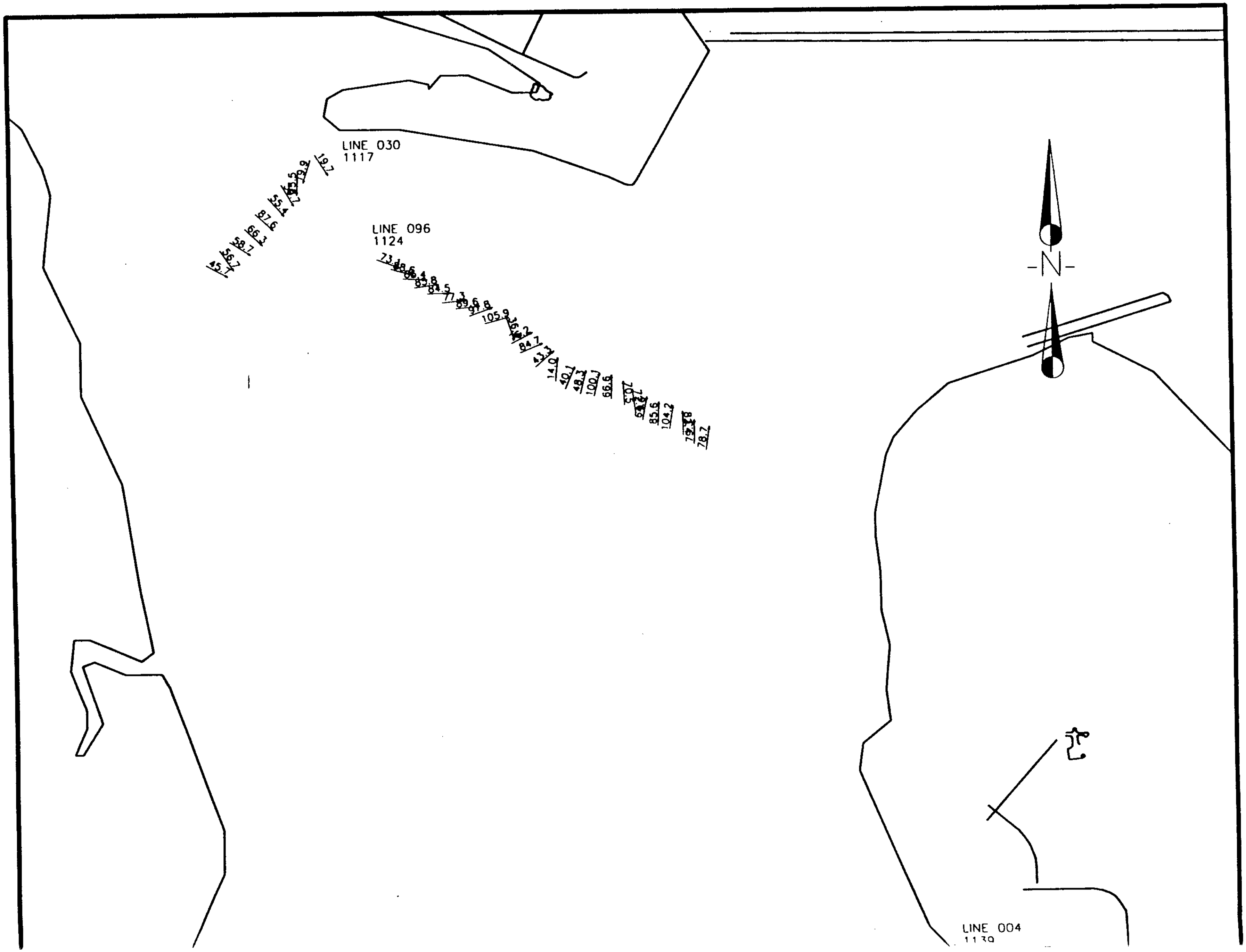
2

Plate A33

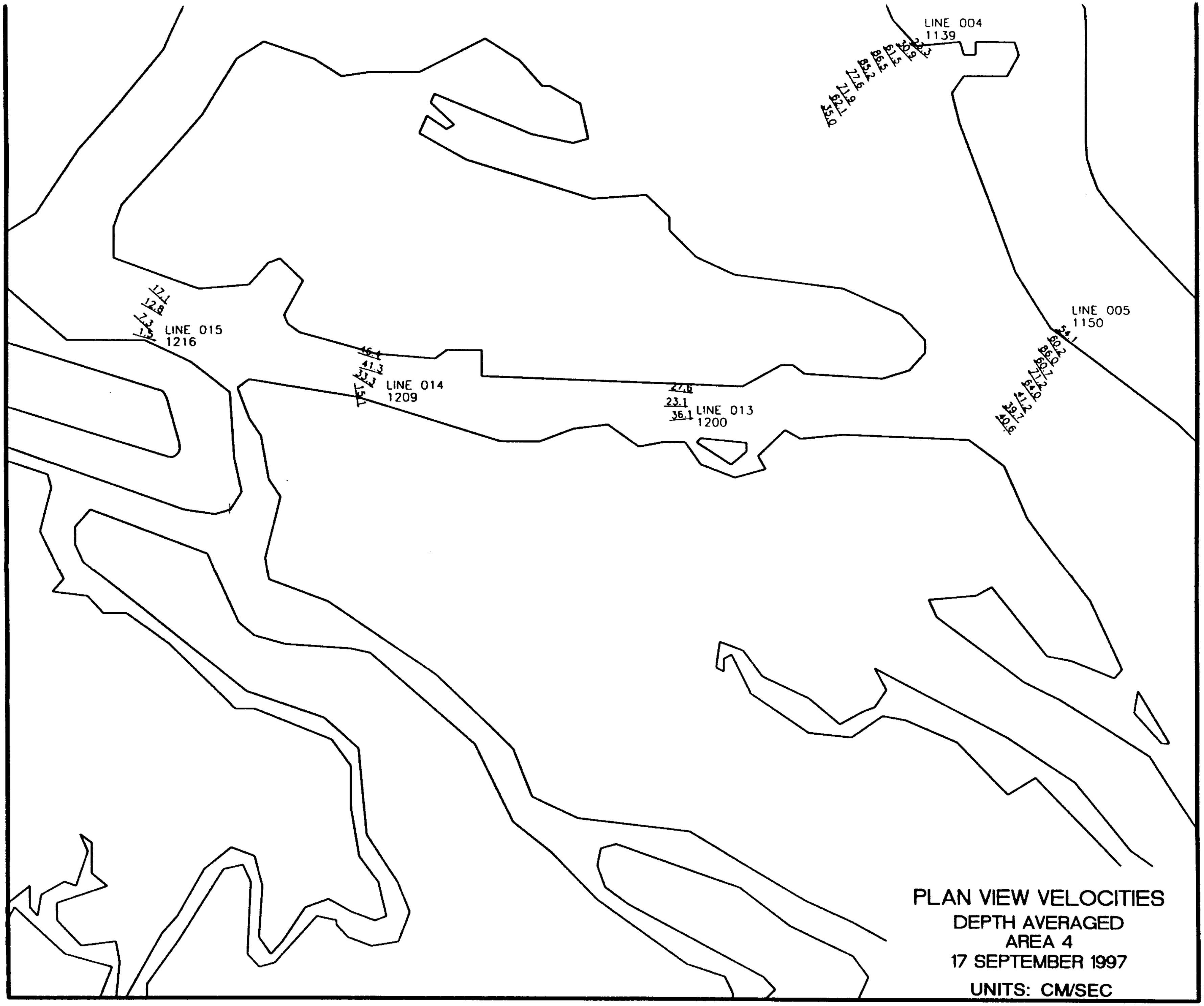

LINE 081
0752
LINE 080
0735



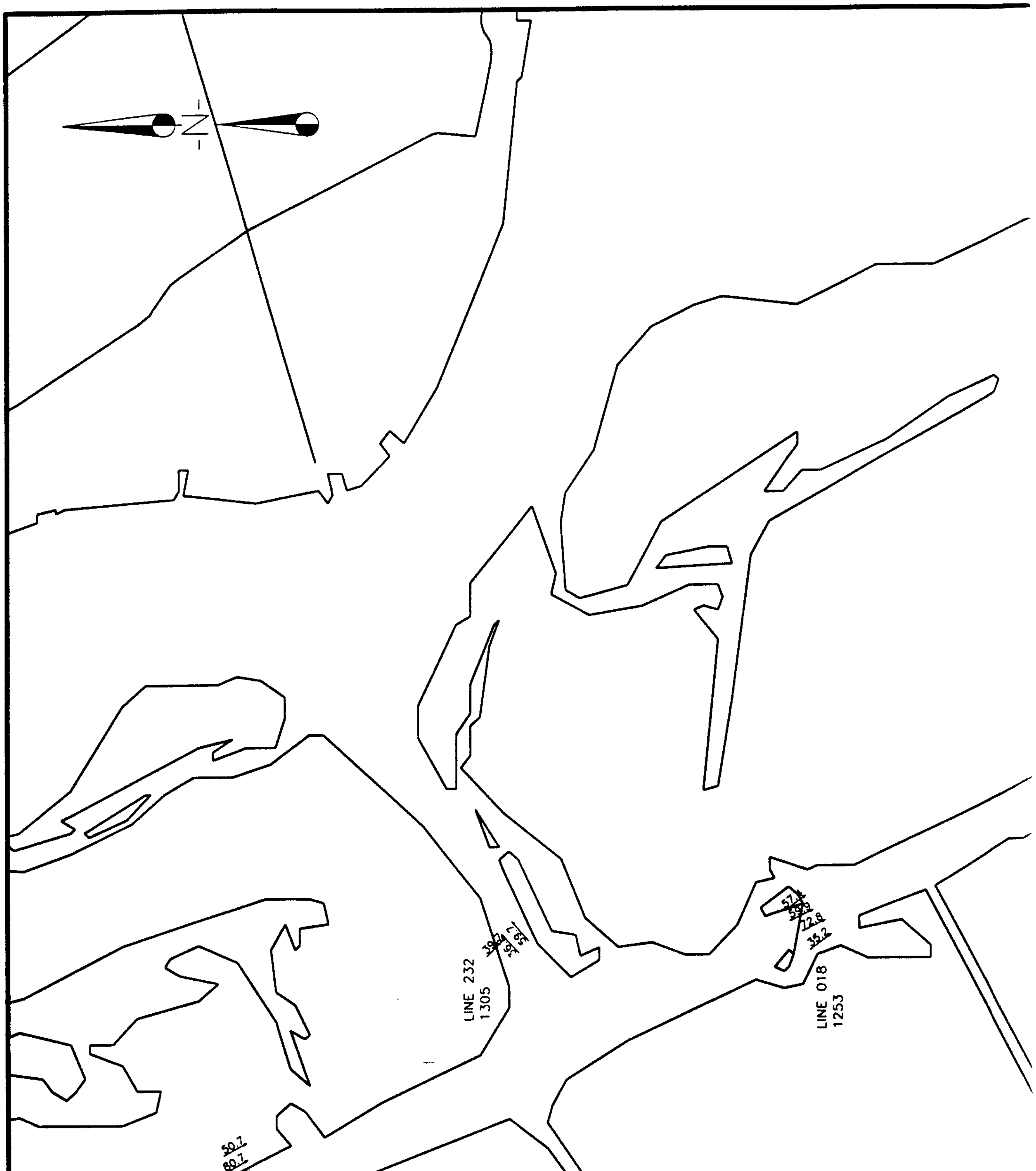
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 6
17 SEPTEMBER 1997
UNITS: CM/SEC


LINE 030
1117
19.7
55.4
87.6
66.3
58.7
56.7
45.7
LINE 096
1124
105.9
84.7
14.0
40.1
48.3
100.1
66.6
70.5
85.6
104.2
78.7
LINE 004

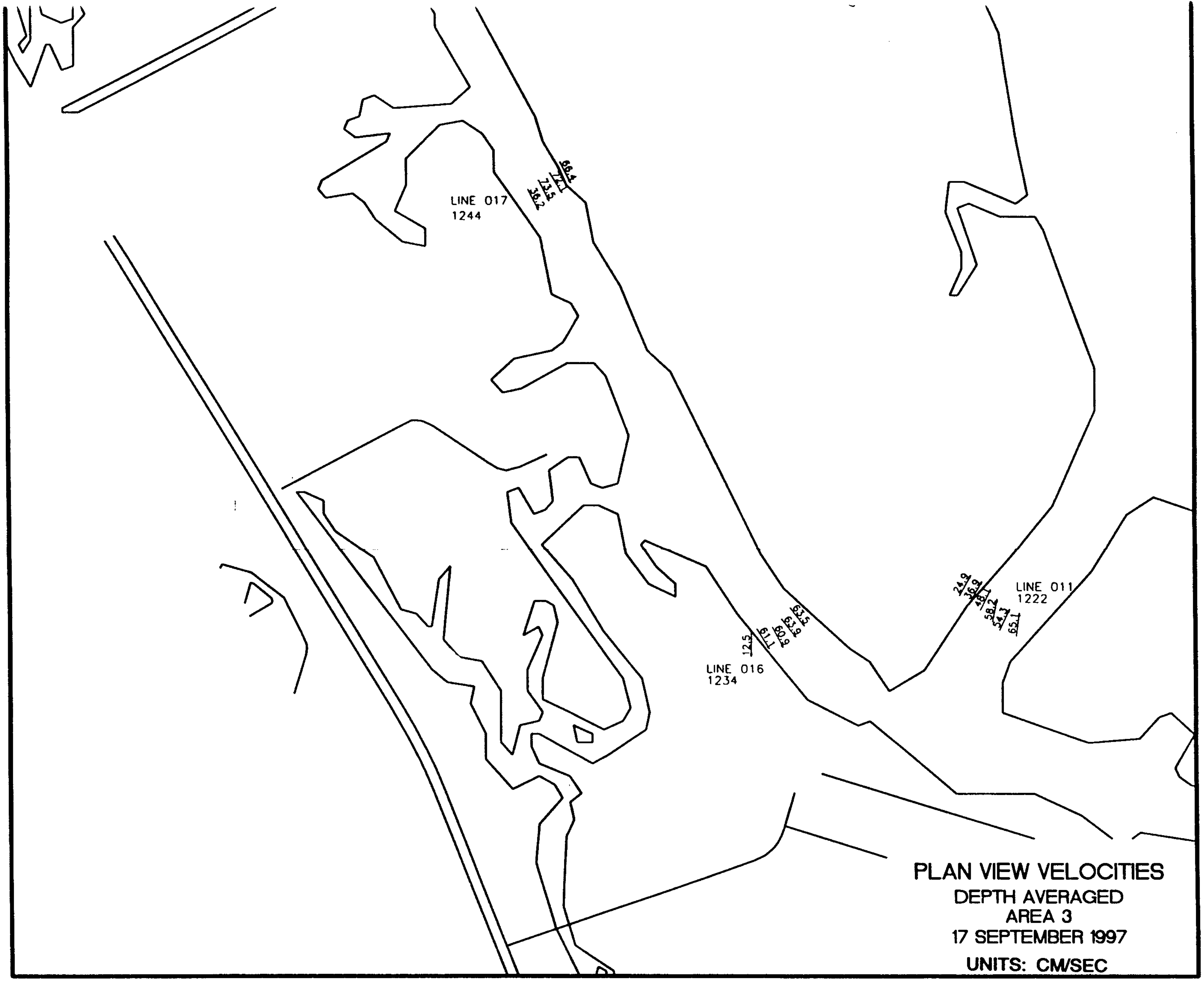
1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
17 SEPTEMBER 1997
UNITS: CM/SEC
LINE 004
1139
22.3
30.9
61.5
86.5
85.2
77.6
71.9
62.1
35.0
LINE 005
1150
54.1
60.2
86.0
60.7
71.2
64.0
41.2
39.7
40.6
LINE 013
1200
27.6
23.1
36.1
LINE 014
1209
46.4
41.3
33.3
15.1
LINE 015
1216
17.1
12.8
7.3
1.5

2

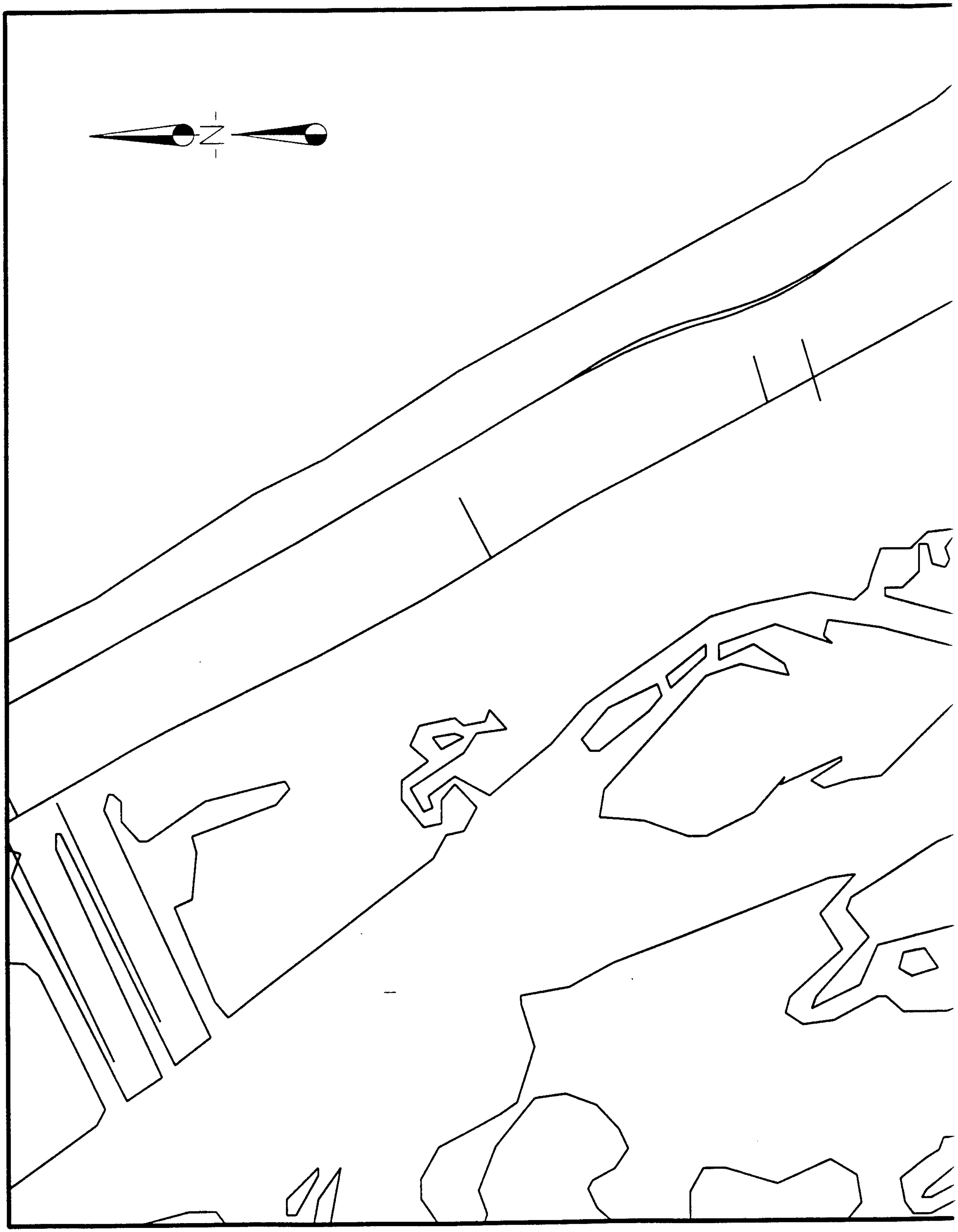


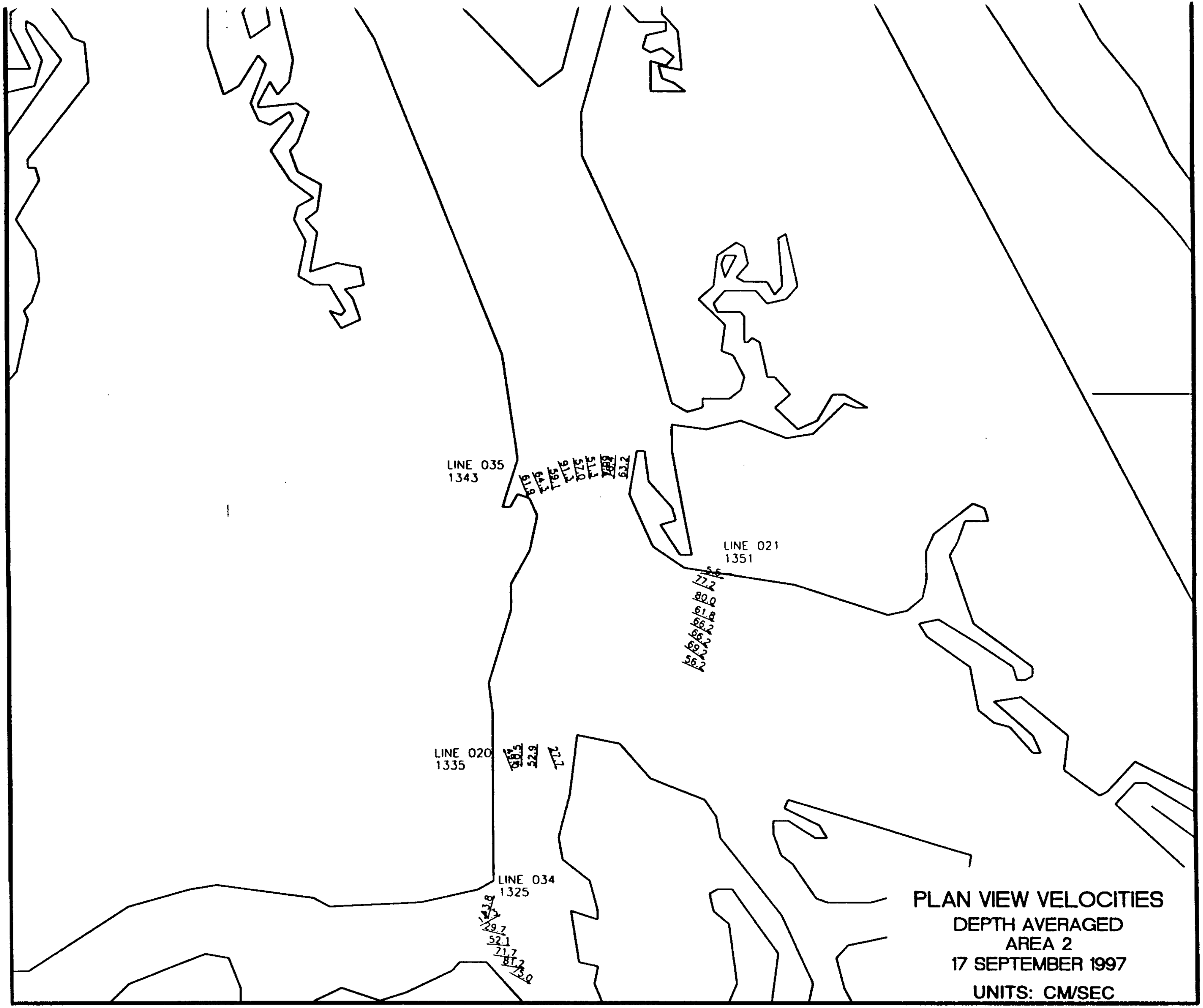
50.7
80.7
67.3
64.8
48.1
LINE 019
1313
59.7
LINE 232
1305
72.8
35.2
LINE 018
1253



PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 3
17 SEPTEMBER 1997
UNITS: CM/SEC

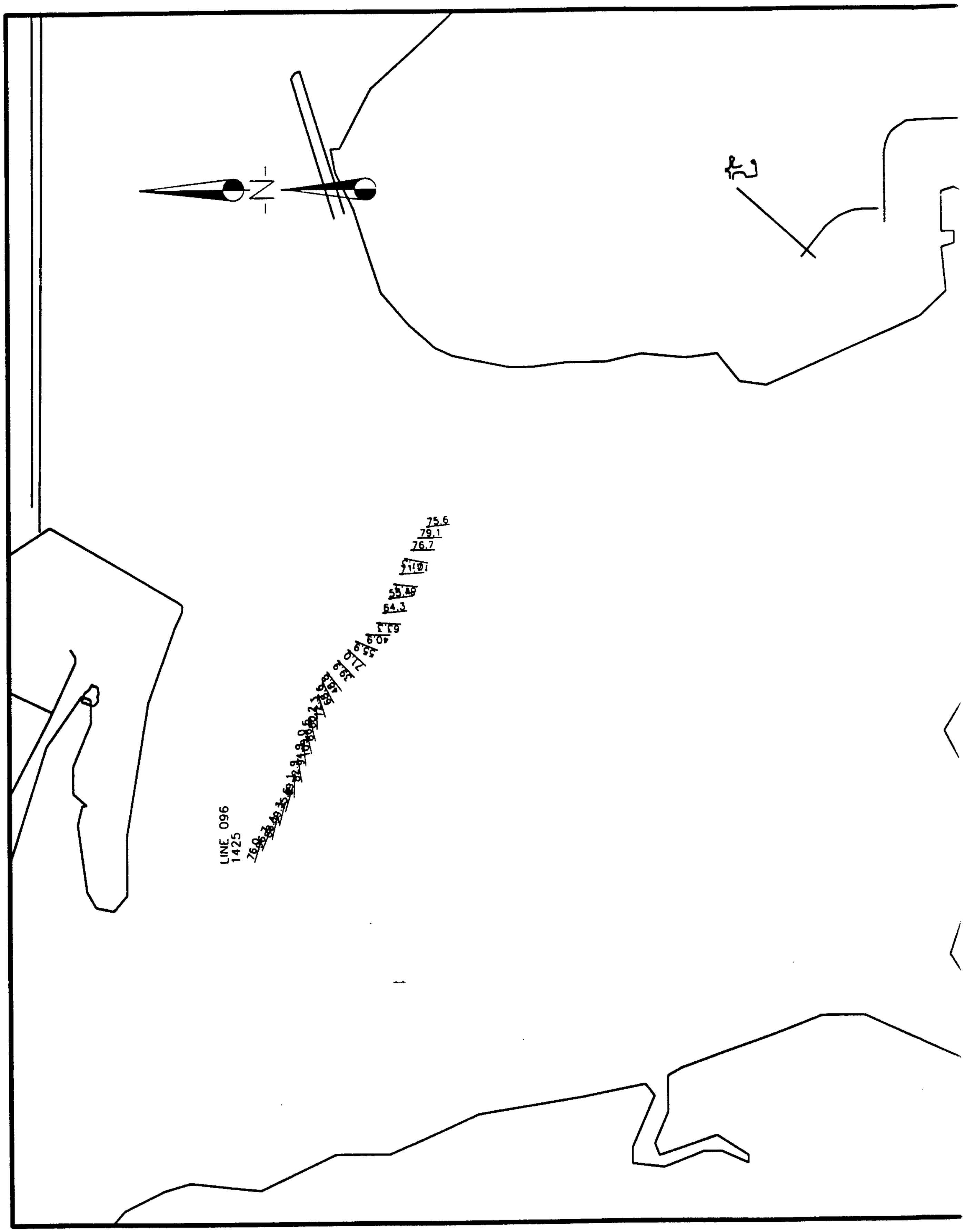
2



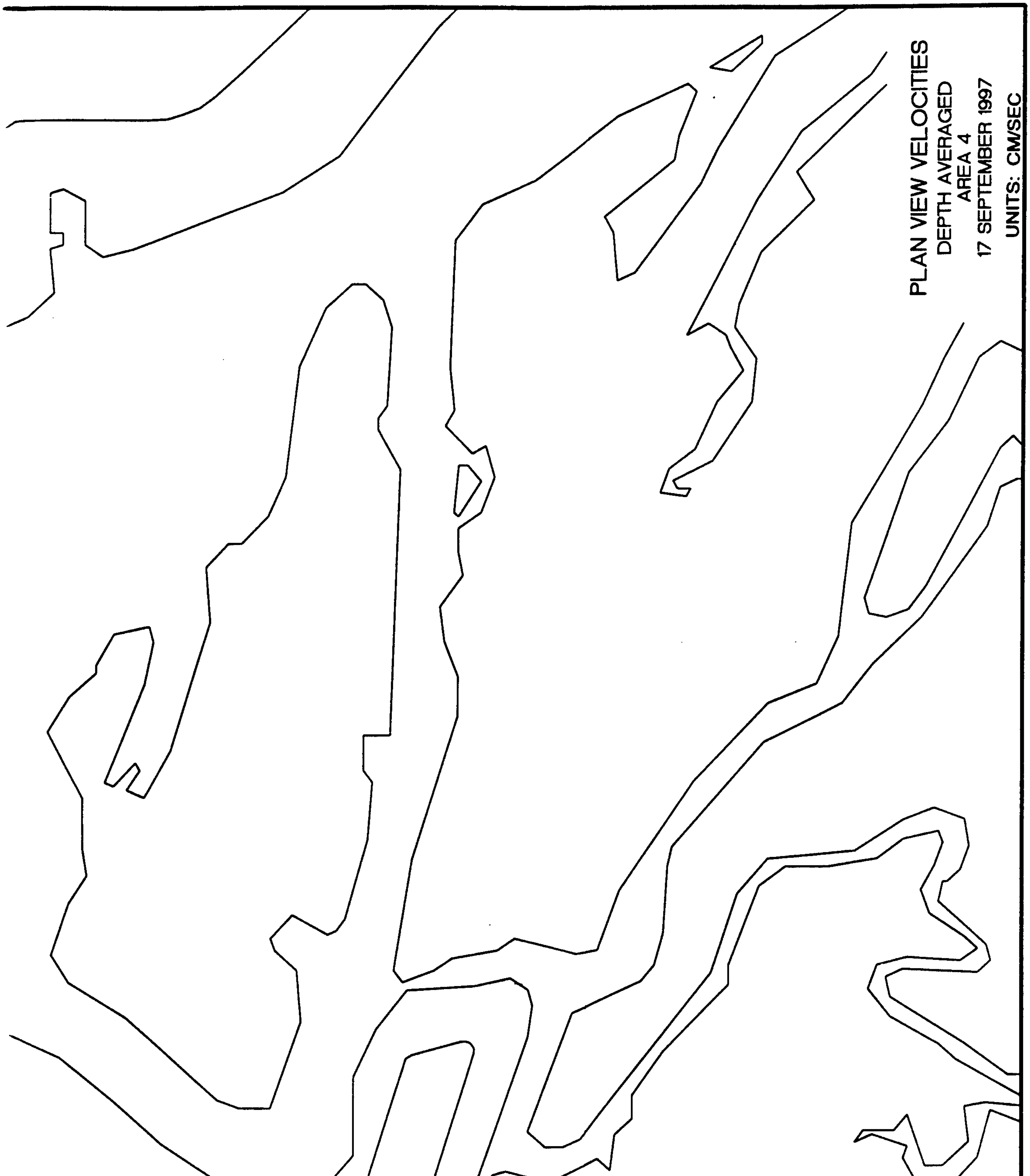

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
17 SEPTEMBER 1997
UNITS: CM/SEC
LINE 035
1343
61.9
64.3
59.1
91.3
57.0
51.3
LINE 021
1351
5.6
77.2
80.0
61.8
66.2
66.2
69.2
56.2
LINE 020
1335
52.9
27.7
LINE 034
1325
29.7
52.1
71.7
81.2
73.0

2

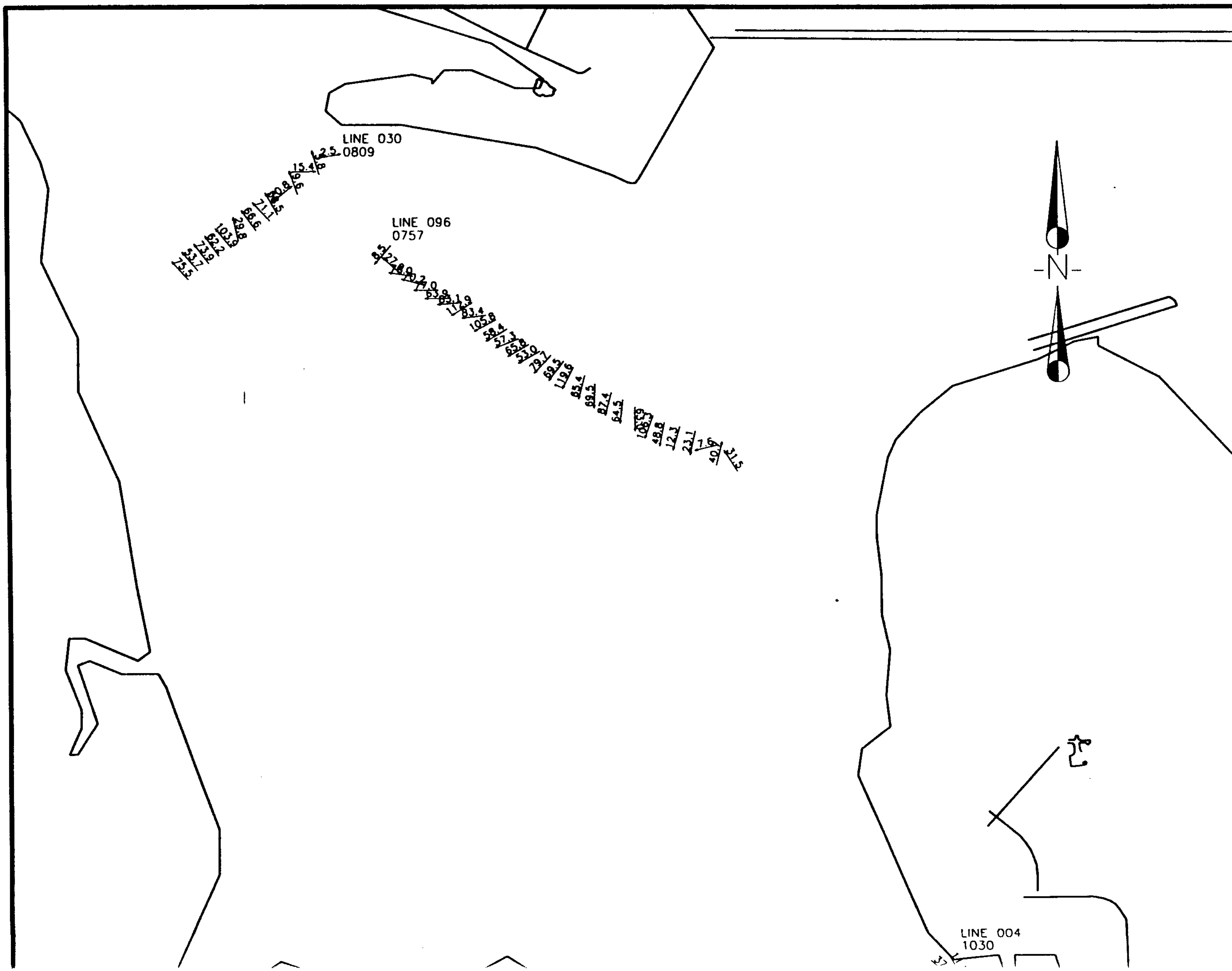
Plate A37



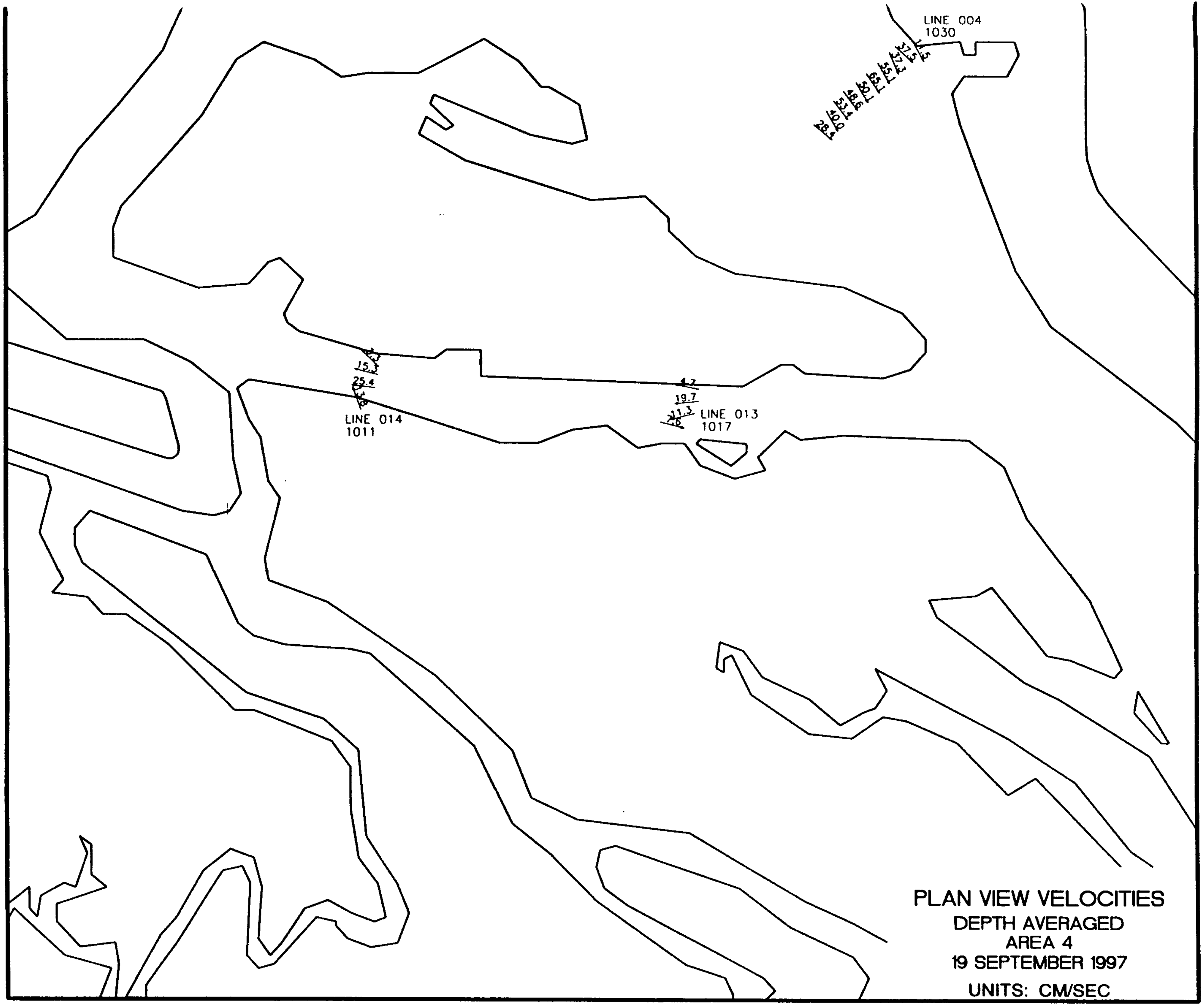
1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
17 SEPTEMBER 1997
UNITS: CM/SEC

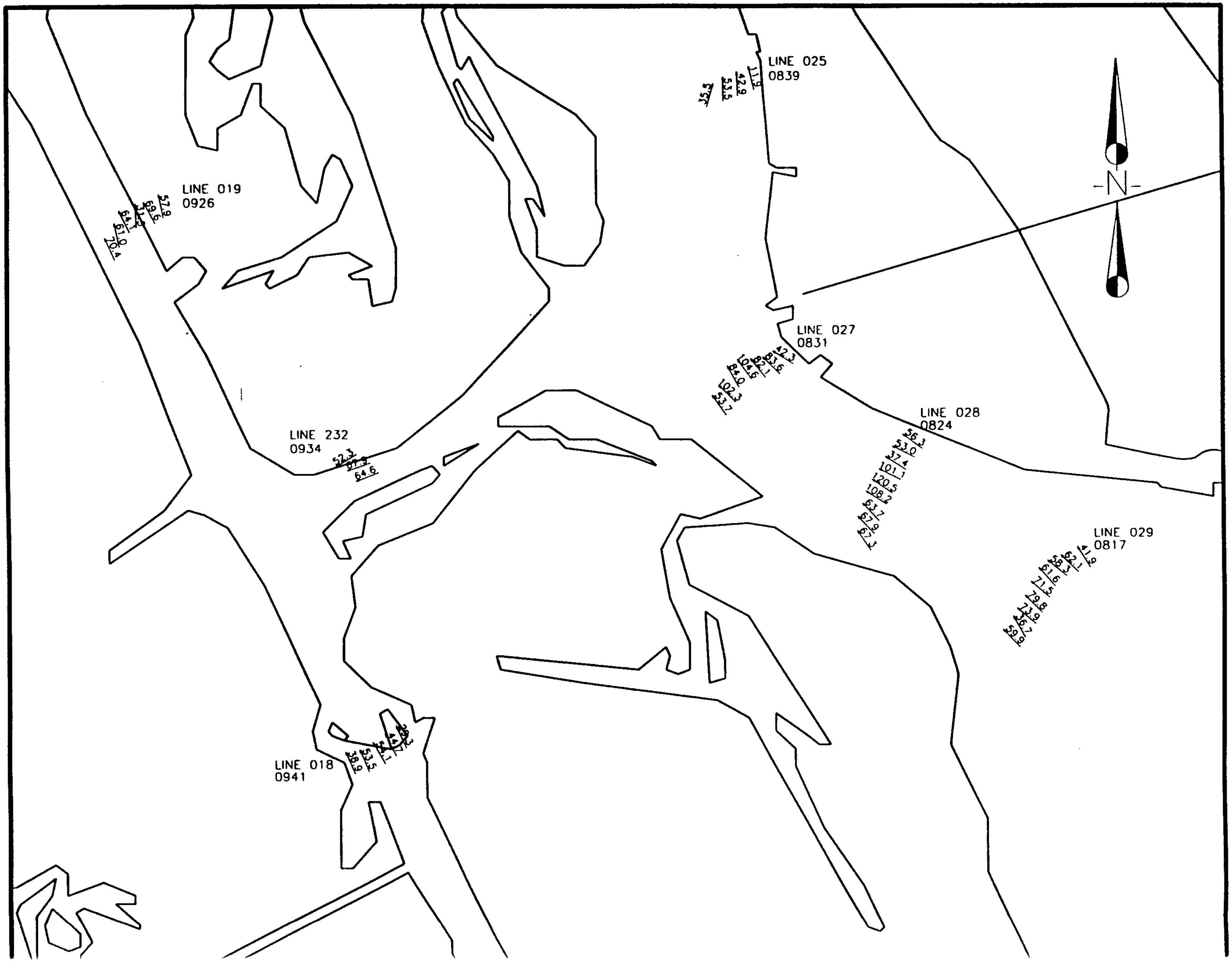
2



1

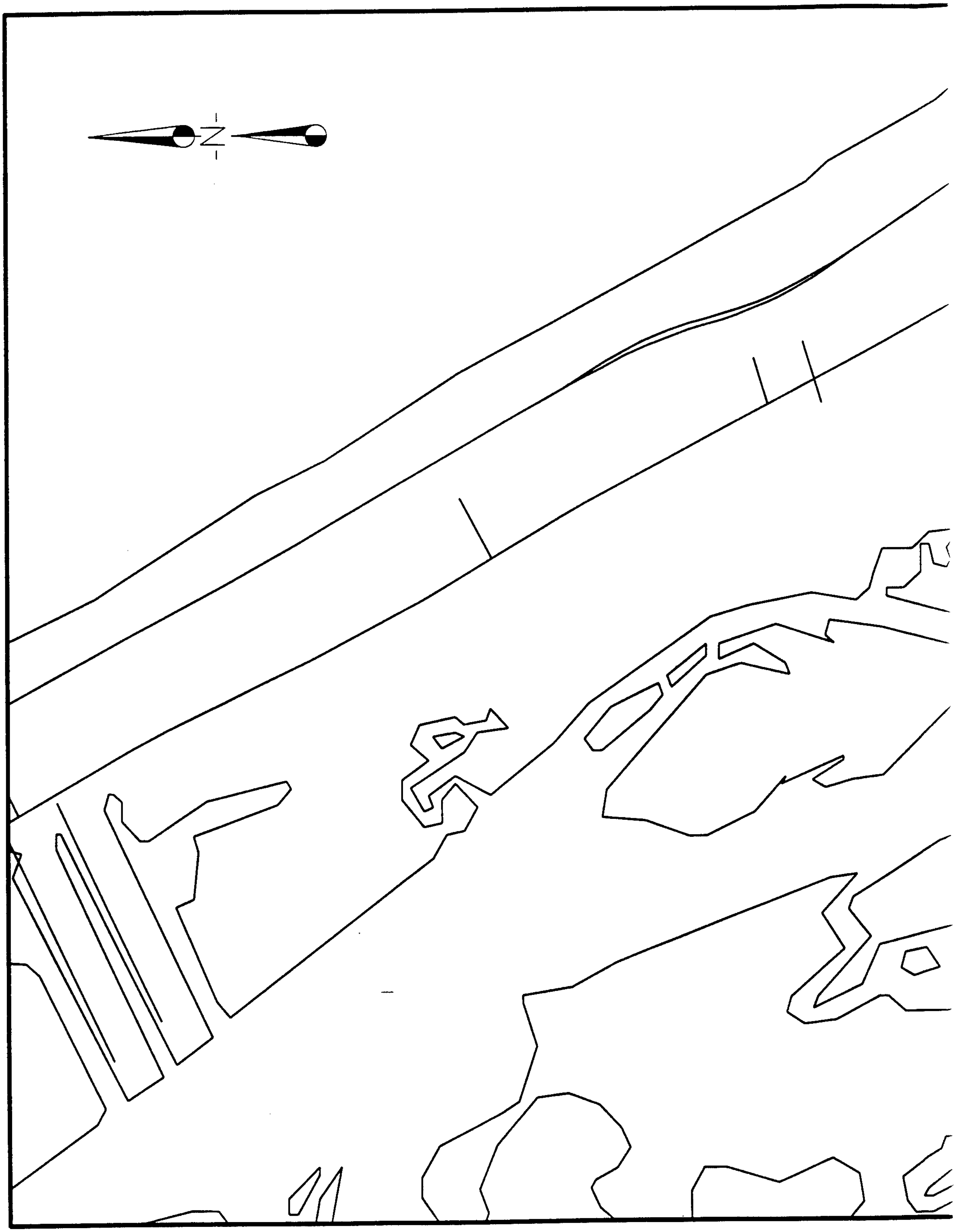

LINE 004
1030
37.5
37.3
55.1
65.1
50.1
48.6
53.4
40.0
28.4
LINE 014
1011
15.3
25.4
LINE 013
1017
19.7
11.3
PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
19 SEPTEMBER 1997
UNITS: CM/SEC

2

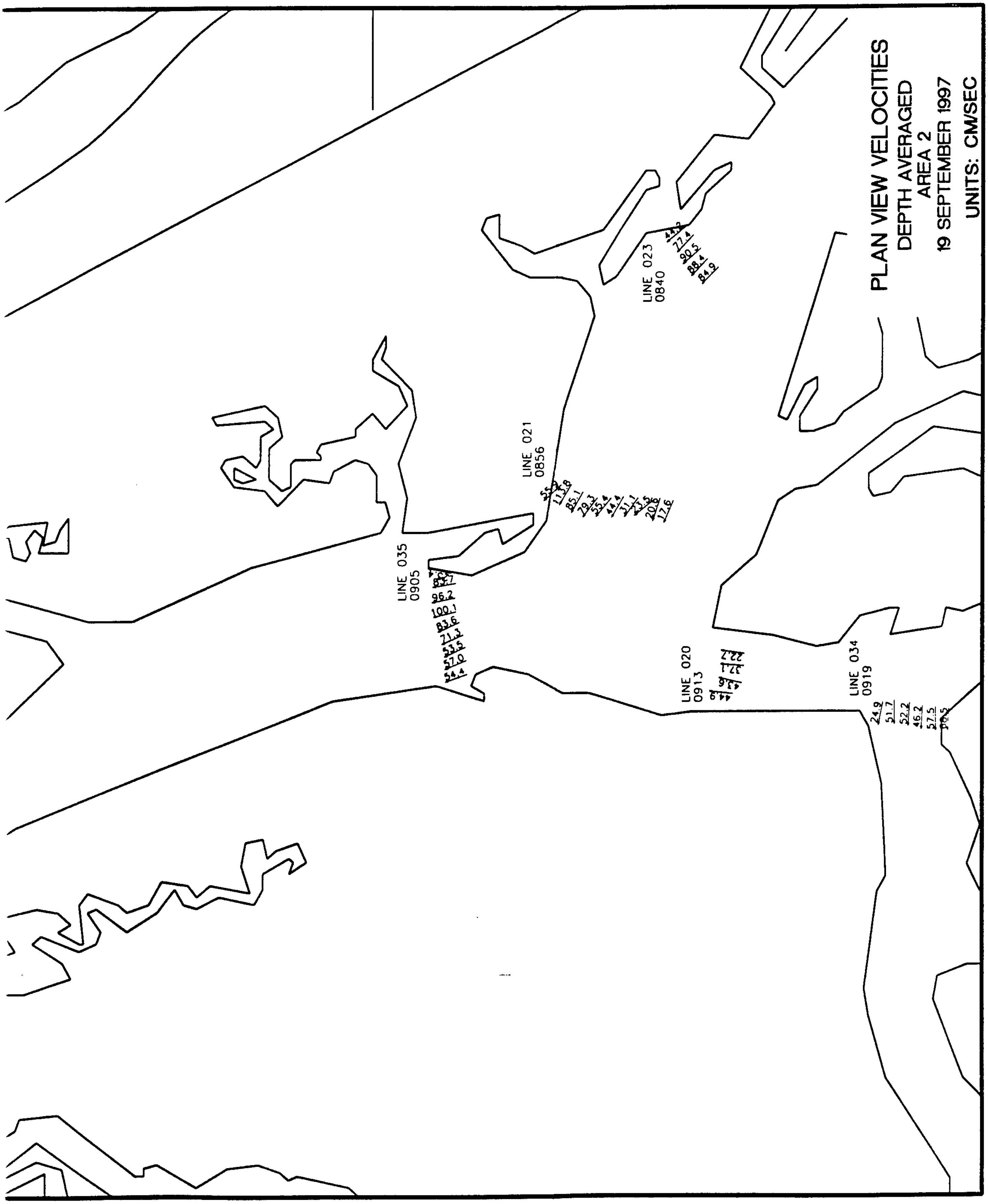

N
LINE 025
0839
11.9
42.9
53.5
35.5
LINE 027
0831
42.3
83.6
82.1
104.6
84.0
102.3
53.7
LINE 028
0824
56.3
53.0
37.4
101.1
120.5
108.2
63.7
67.9
67.2
LINE 029
0817
41.9
62.1
58.3
61.6
71.5
79.8
73.9
36.7
59.9
LINE 019
0926
57.9
69.6
64.1
61.0
70.4
LINE 232
0934
52.3
64.6
LINE 018
0941
53.5
38.9

PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 3
19 SEPTEMBER 1997
UNITS: CM/SEC

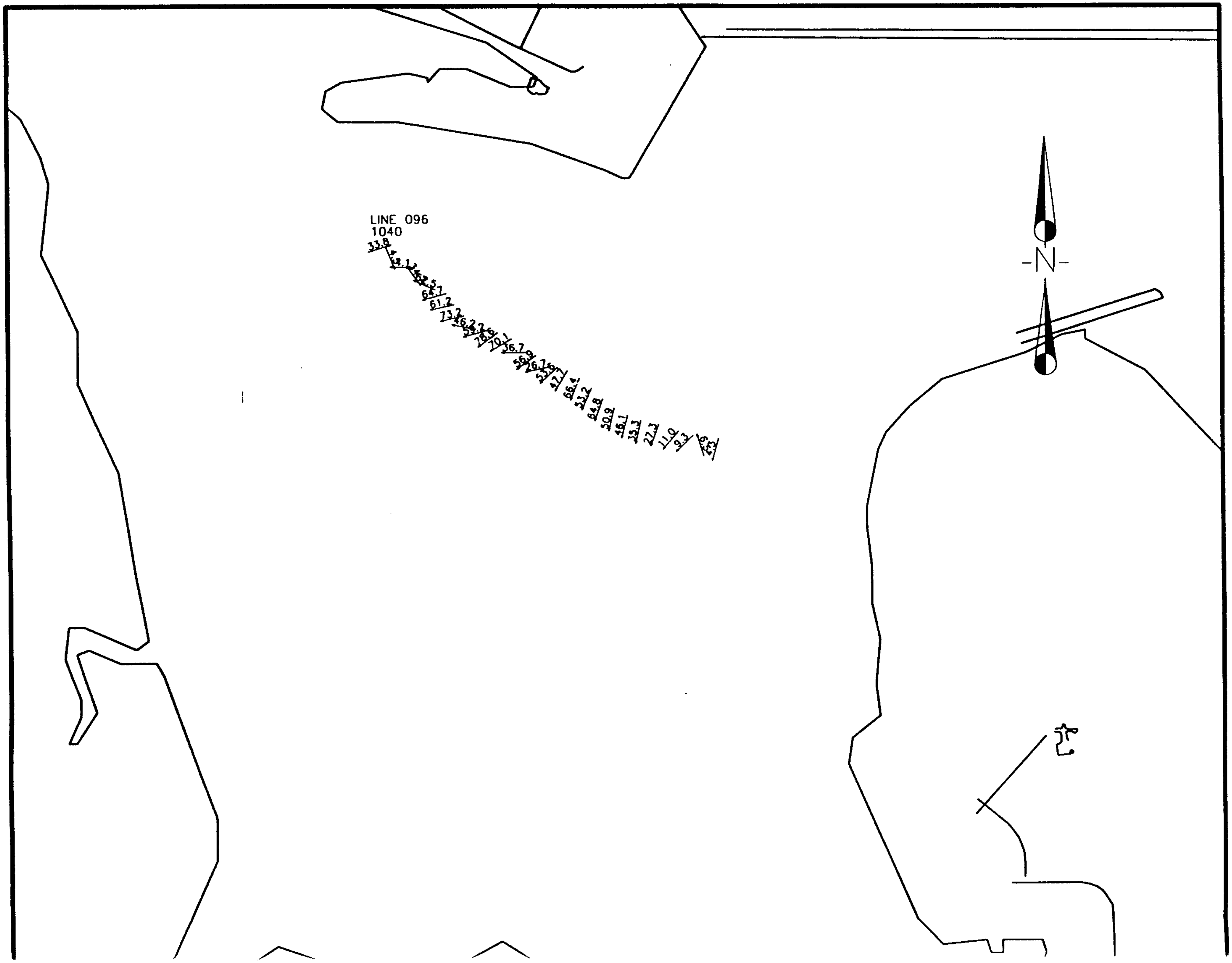
2



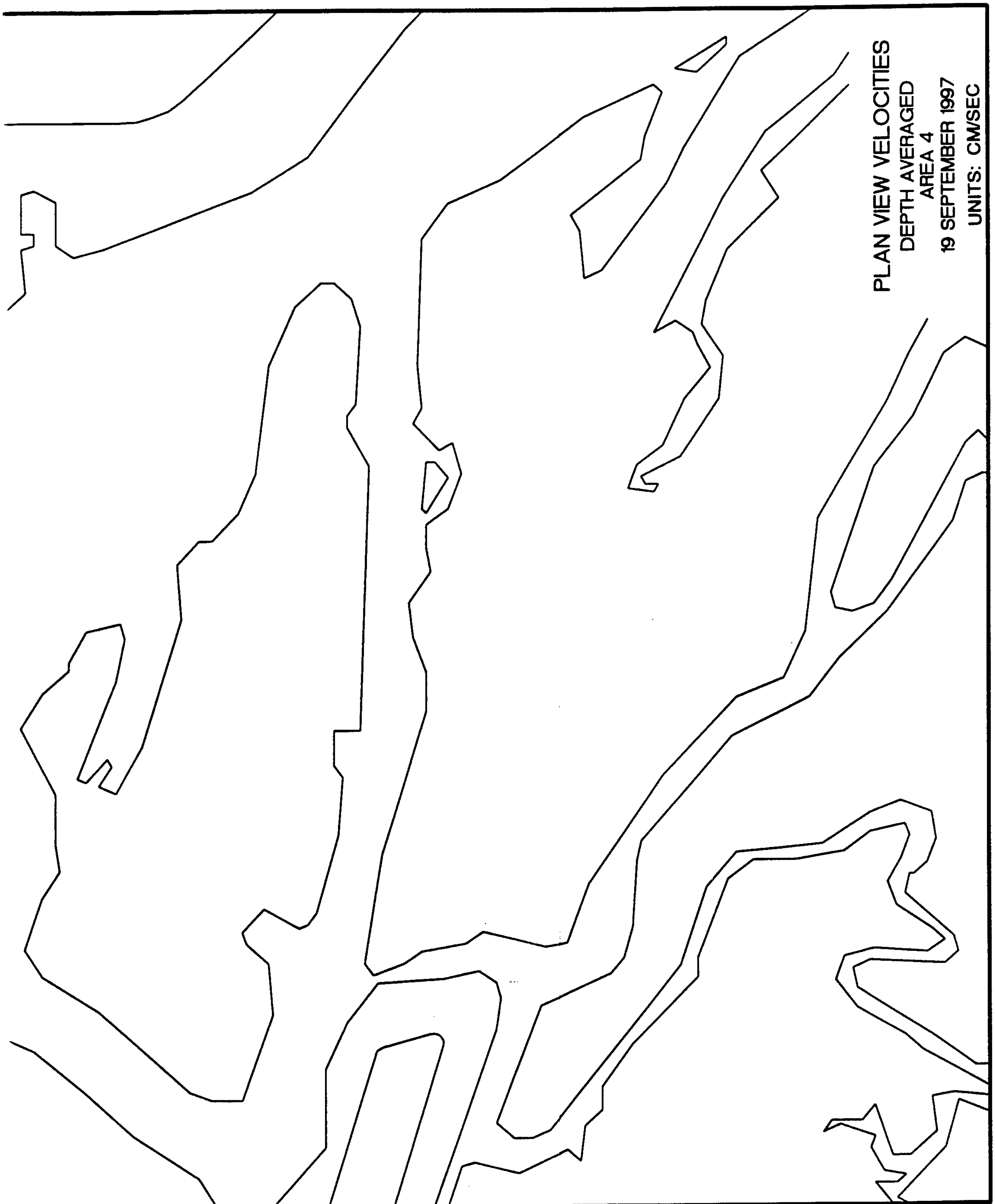
1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 2
19 SEPTEMBER 1997
UNITS: CM/SEC
LINE 023
0840
LINE 021
0856
LINE 035
0905
LINE 020
0913
LINE 034
0919

(2)


LINE 096
1040
33.8
64.7
61.2
73.2
36.7
47.7
66.4
53.2
64.8
50.9
46.1
35.3
27.3
11.0
9.3
N

1


PLAN VIEW VELOCITIES
DEPTH AVERAGED
AREA 4
19 SEPTEMBER 1997
UNITS: CM/SEC

2

Plate A42

Appendix B
Aerial Photography

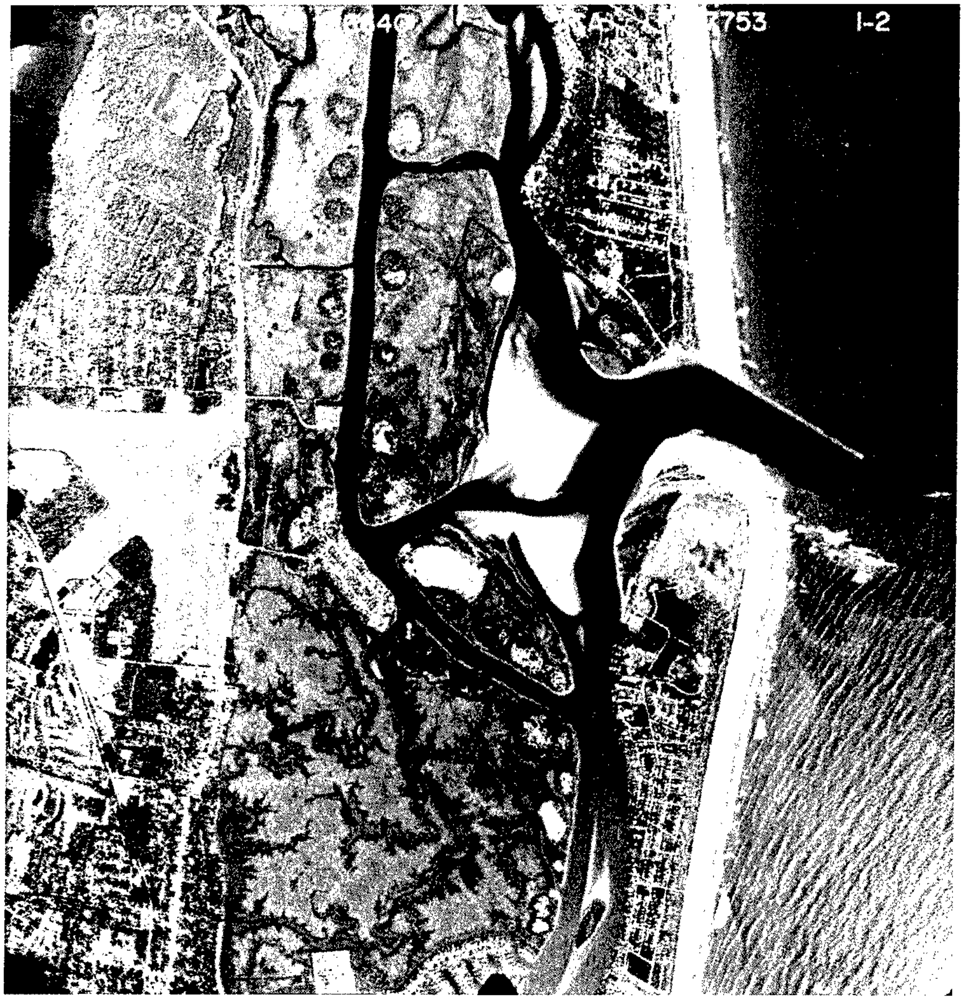


Photo B1. Ponce de Leon Inlet, 10 September 1997

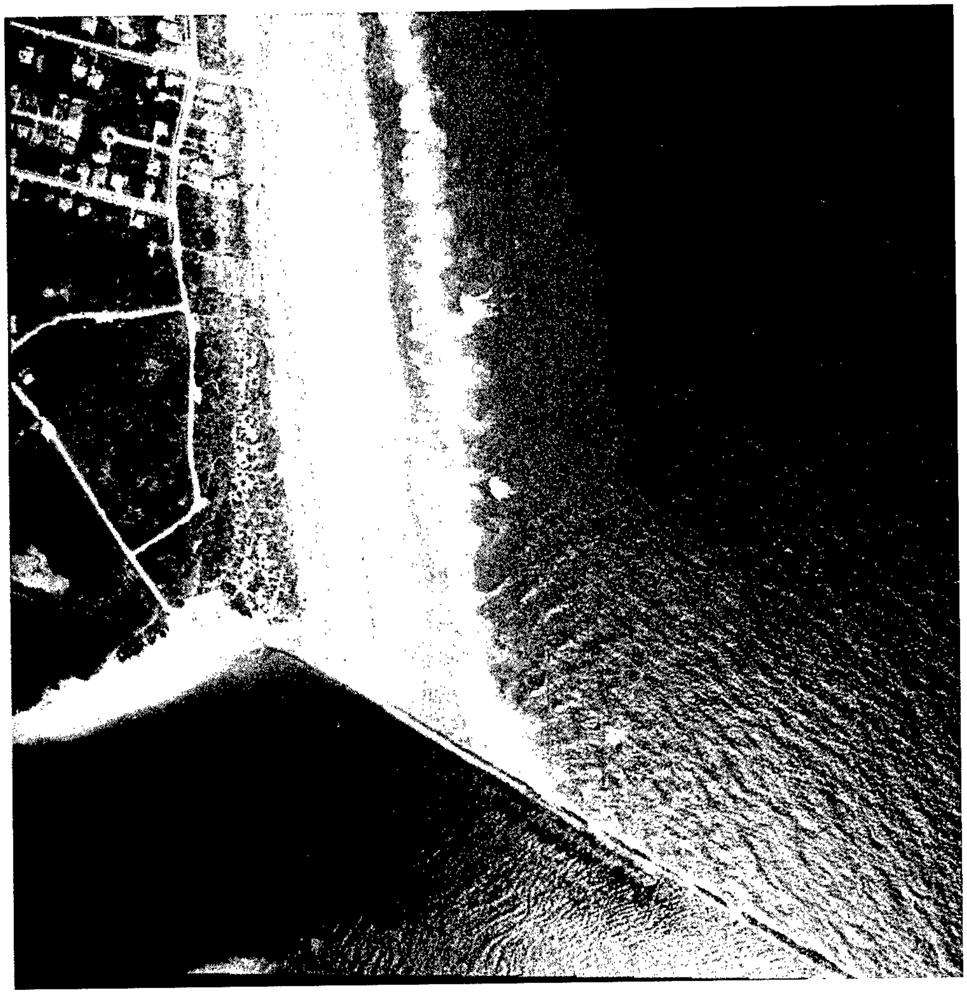


Photo B2. North jetty, 21 March 1996

Photo B3. Inlet throat, 24 September 1996

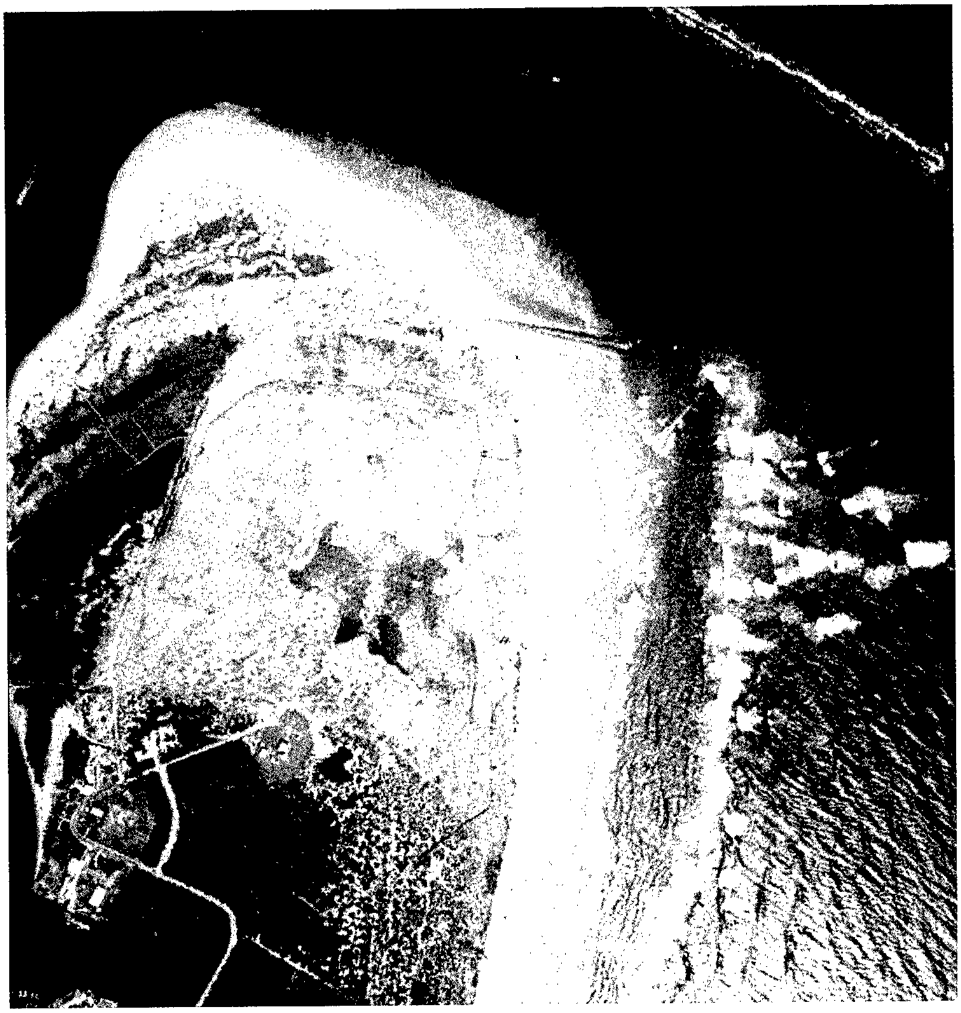


Photo B4. South jetty, 24 September 1996

Photo B5. Flood shoals, 24 September 1996

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	January 1999	Report 1 of a series

4. TITLE AND SUBTITLE
Ponce de Leon Inlet, Florida, Site Investigation; Report 1, Selected Portions of Long-Term Measurements, 1995-1997

5. FUNDING NUMBERS

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report CHL-99-1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The U.S. Army Corps of Engineers, Coastal Inlets Research Program, conducted a long-term comprehensive monitoring program at Ponce de Leon Inlet, Florida, beginning in September 1995 and ending in October 1997. The monitoring program consisted of multiple gauge sites to collect data on wave height, wave period, wave direction, water level, current velocity, and wind velocity. Additional data were obtained through bathymetry surveys, the collection of sediment samples, and inlet monitoring with video imagery and aerial photography. This report describing the available data, discusses the data collection and processing procedures used, and presents examples of the data collected during three time periods of interest.

14. SUBJECT TERMS

Bathymetry data	Ponce de Leon Inlet, Florida
Coastal Inlets Research Program	Sediment data
Current data	Water level data
Field data	Wave data
Inlets, Florida	Wind data

15. NUMBER OF PAGES
147

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		